



INDUSTRY

TEAM

MILITARY

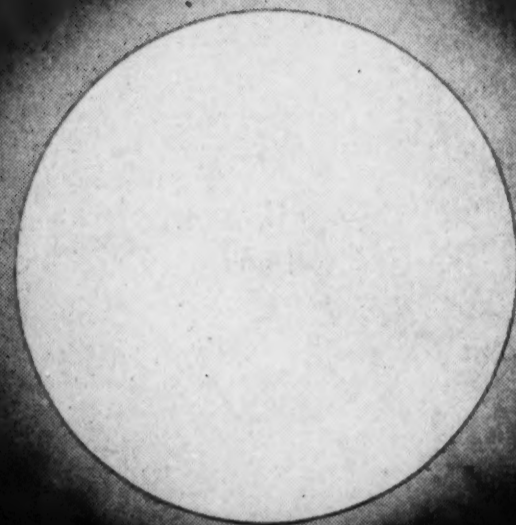


NEW HORIZONS: time and distance in full retreat

15th

AFCEA
CONVENTION ISSUE

JUNE 6-7-8, 1961



midnight



75 kw

...or new anywhere, for that matter, but first utilized by Western Electric in its installation of the DEW East early warning system for that segment spanning the arctic wastes from Iceland to Greenland.

The Air Force required a tropo scatter transmitter providing 50 kw output—five times more powerful than any known—with reception of 48 voice channels at 440 miles. REL's pioneering engineers developed apparatus capable of 75 kw output—seven and one-half times more powerful!

For the first time, regardless of weather, spans of 500 miles or more can be linked with great reliability. At such range, the equipment permits transmission of 72 simultaneous conversations. Shorten the distance between stations, and the number can be increased to 240.

These unique 75 kw tropo scatter units join earlier REL installations to lengthen and strengthen the vital communications line so necessary for our nation's defense.



A subsidiary of Dynamics Corporation of America

Dept. 5 • 29-01 Borden Ave • Long Island City 1, NY

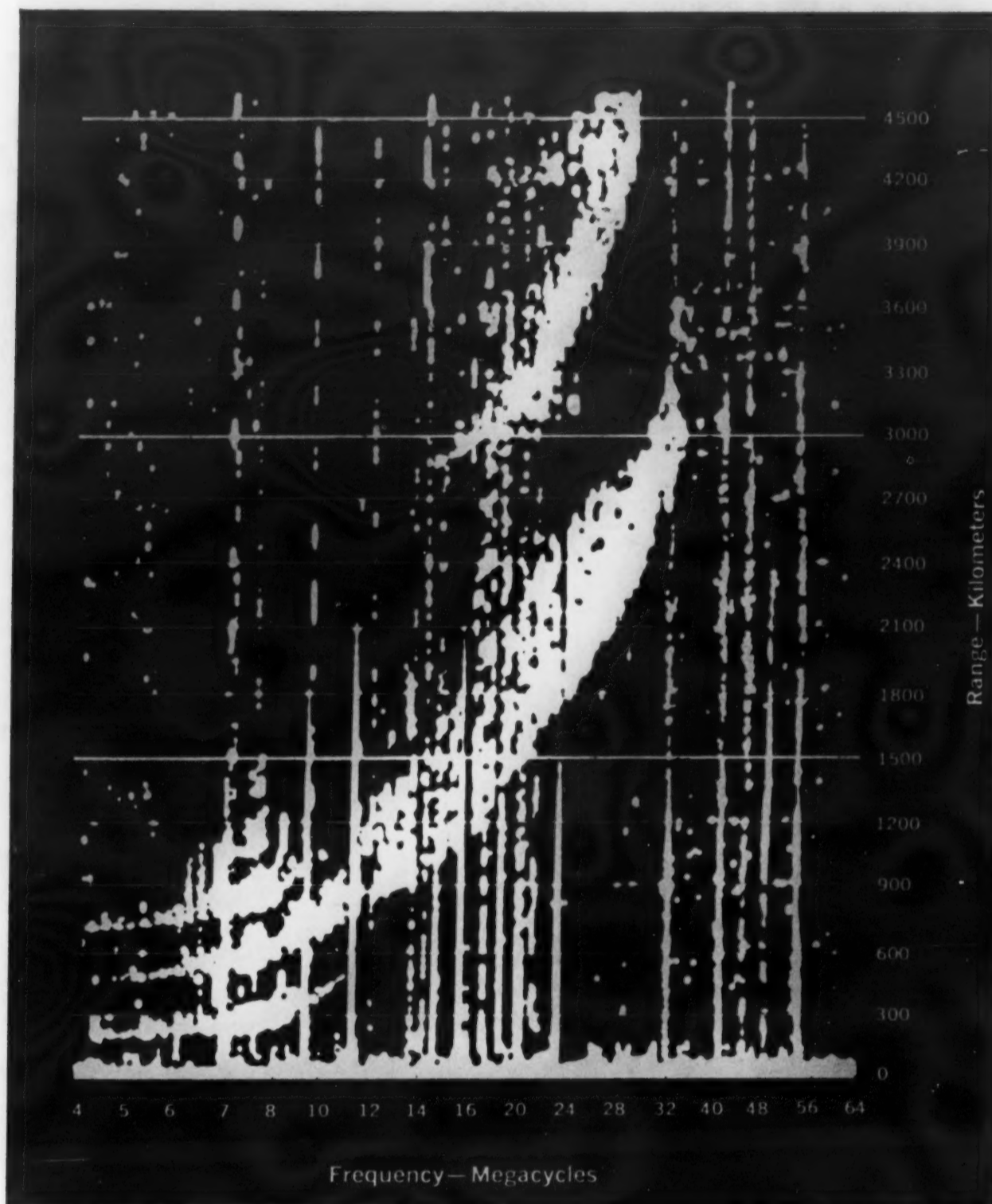
Creative careers at REL await a few exceptional engineers. Address resume to James Kelly, Personnel Director.

Granger Associates fast-stepping ionosphere sounder

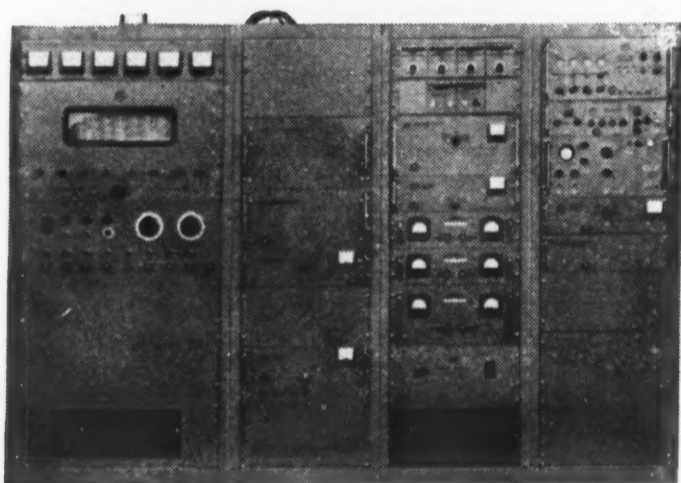
Backscatter or synchronized oblique sounding.

4-64 MC IN 3.2 SECONDS

*for rapid, precise
measurement of ionosphere
parameters on a continuous basis.*



Typical oscilloscope record shows vertical incidence and backscatter returns using G/A Model 902



Sounder and G/A Pulse Distributed Power Amplifier.



The G/A 902 step-frequency ionosphere sounder is a multi-channel electronically-stepped high-power transmitter/receiver operating in the h-f band. 160 frequencies, from 4 to 64 megacycles, are derived from a single stable reference, and are electronically selected at rates up to 50 frequency changes per second. Operation is entirely electronic—there are no mechanical switches or tuning devices. Associated power amplifiers are available with pulse power outputs up to 100 kw.

Research Applications: Because of its simultaneous time and frequency resolution capabilities, this sounder is especially suited for observing auroral ionization, artificial ion clouds and ionized meteor trails. Other research applications include the observation

of traveling disturbances at either oblique or vertical incidence.

Communications Applications: This sounder can be used with a steerable or fixed antenna to provide a continuous and essentially instantaneous display of the coverage area for one-hop ionospheric transmission. Two-hop and even higher order modes are displayed a substantial portion of the time.

For direct measurement of path loss, two or more sounders can be synchronized to provide an instantaneous display of path loss and/or path delay vs. frequency between circuit terminals.

A thirty-five page Granger Associates report gives you full specifications and operating principles on the sounder and related information on antenna systems. We'll be happy to send you a copy —airmail.

Send For Complete Information

GRANGER ASSOCIATES / 974 Commercial Street / Palo Alto, California / DAvenport 1-4175

IRE will be at AFCEA.....

**June 6-8, Shoreham Exhibit Hall
Washington, D. C.**



**Visit us at the AFCEA Convention.
Membership information for Engineers,
Special Issues, Professional Group data
and the new, cloth-bound, 6" x 9 $\frac{1}{4}$ " book
"IRE Dictionary of Electronic Terms
and Symbols".**



The Institute of Radio Engineers
1 East 79th Street, New York 21, N. Y.



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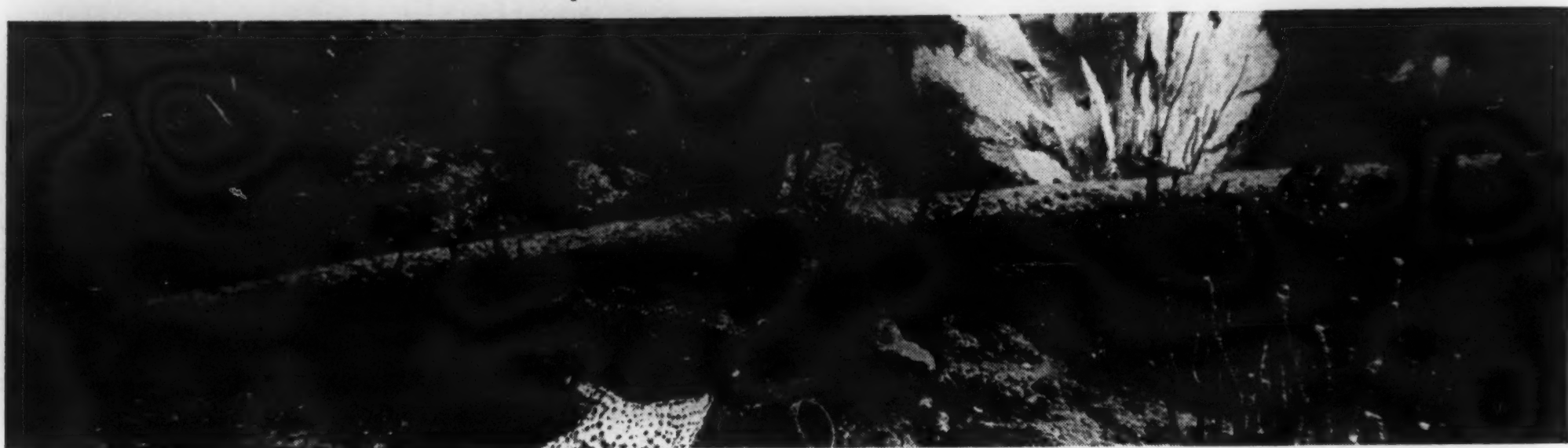
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from the reaches of space

Unretouched time exposure shows Echo I communications satellite (long line) crossing heavens right to left. Shorter lines are stars "in motion."



to the depths of the sea

Actual undersea photo of telephone cable off coast of Florida.



we use all of the arts of communication to serve you better

One of our biggest capabilities is providing defense communications—wherever needed.

If we can't fill communications needs off the shelf, then we'll start fresh and create the answers to the problems. We've done that hundreds of times.

We recently handled the world's first telephone conversation *via satellite*. And we have started development of a world-wide communications system employing satellites.

We developed the world's first undersea telephone cables to speed calls between continents.

When industry and government needed a way of gathering huge amounts of coded information from distant

points, we were ready with our vast telephone network and Data-Phone, which transmits at extremely high speeds.

Far in the frozen north, our engineers are putting together the communications system for BMEWS, the nation's Ballistic Missile Early Warning System.

For strategic defense installations, we provide a Group Alert and Dispatching System making it possible for one pull of the dial to ring up to 480 telephones *simultaneously*.

Universal communications—the finest, most dependable anywhere—are what we deliver. Inside, outside, on land, under the sea, through the air, or into space.

We invite inquiries.

BELL TELEPHONE SYSTEM



AMERICAN TEL. & TEL. CO. / WESTERN ELECTRIC CO. / BELL TELEPHONE LABORATORIES / 21 OPERATING COMPANIES

THE WHITE HOUSE

WASHINGTON

May 5, 1961

Dear Colonel Baird:

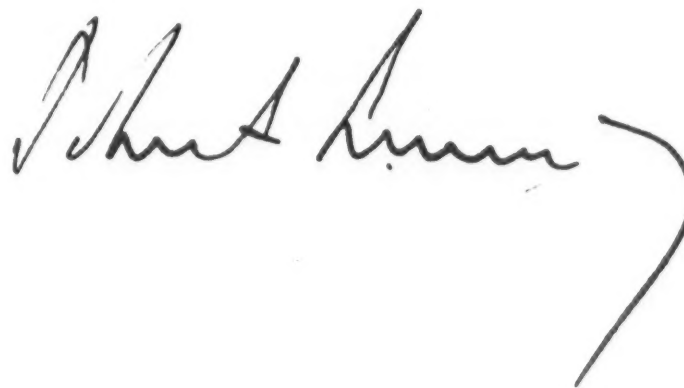
On the occasion of the Fifteenth Annual Convention of the Armed Forces Communications and Electronics Association, I send greetings to all those attending.

The Convention theme, "New Horizons with Time and Distance in Full Retreat," signifies the alertness of your Association to the vital need for timely and accurate information in a changing world.

Your members are helping to develop our nation's resources to meet the challenges of this era by providing that important link of communications and electronics facilitating a better understanding among nations.

My congratulations on your Fifteenth Anniversary and best wishes for an outstanding Convention.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "John F. Kennedy", with a long, sweeping flourish extending from the end of the signature.

Colonel W. J. Baird, USA (Ret.)
General Manager and Editor
Armed Forces Communications and
Electronics Association
1624 Eye Street, N. W.
Washington 6, D. C.



B. H. OLIVER, JR.
National President, AFCEA
Vice President Upstate
New York Telephone Company

AFCEA'S ROLE

ANY ORGANIZATION MUST have good and sufficient reasons for its existence, and ours is no exception in this respect. We have one fundamental underlying responsibility for being. This is so important in its contribution to the nation's welfare that it must never become obscure. I refer, of course, to AFCEA's primary mission, which is to see that communicators, and people in the fields of electronics and photography, in military and in civilian life, have close liaison with each other. This closeness of relationship is not a nicety, but a necessity. When the time comes, if it does, that the Nation's security requires military communicators, and those engaged in electronics and photography fields to run in double harness with their counterparts in civil life, there will be hardly enough time to get hitched up. And hitched up we must be if this nation is to draw the strength from this group that it has the right to demand of us. Communications has always been important to our Nation, but today's greatly broadened concept of communications attaches a significance to good performance in these areas that is so vital one can only think about it in terms of survival.

Convention Speakers

KEYNOTE LUNCHEON SPEAKER



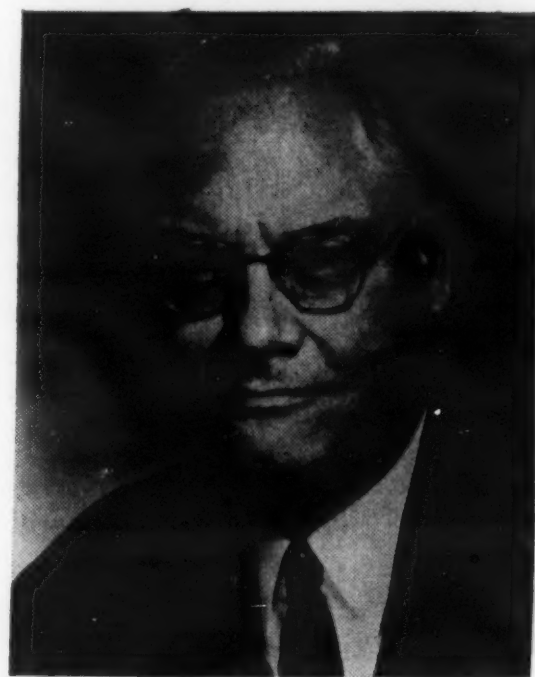
Richard S. Morse, Assistant Secretary of the Army (Research and Development)

Secretary Morse is recognized as one of the early pioneers in the field of high vacuum technology and, as a technical executive, outstandingly experienced in the organization and management of business ventures resulting from research and development. Richard Morse is a graduate of the Massachusetts Institute of Technology and holds honorary degrees of Doctor of Engineering and Doctor of Science. Following graduate work in physics at the Technische Hochschule, Munich, Germany, he spent five years in research work at Eastman Kodak Company. He has served as president of many corporations. For many years associated with the National Defense effort, Mr. Morse has acted as Civilian Advisor to the Atomic Energy Commission and the Ordnance Research and Development Advisory Committee, the Technical Advisory Panel of the Department of Defense on Chemical and Biological Warfare and the Defense Science Board. He has recently served as Chairman of the Army Scientific Advisory Panel and as Director of Research and Development for the Army. This year, Mr. Morse was presented the U. S. Army Distinguished Civilian Service Award.



BANQUET SPEAKER

Mr. Kappel began his career digging holes for telephone poles in his native Minnesota in the summer of 1924. In nineteen years with the Northwestern Bell Telephone Company he held jobs ranging from digging post holes to vice president of operations and director of the company. Early in 1949, Mr. Kappel moved to New York as vice president in charge of Long Lines for AT&T, then, in November of 1949, became vice president, operation and engineering. Some four years later he was elected president of Western Electric Company, manufacturing and supply unit of the Bell System, and on September 19, 1956, became the ninth president of AT&T. He is a U. of Minn. graduate and holds 3 honorary LL.D. degrees and an honorary LL.C.D. degree. Mr. Kappel delivered the 1960 McKinsey Foundation Lectures before the Graduate School of Business of Columbia University. He was named to the U. S. Advisory Council for the International Industrial Conference and is a director of AT&T, the Chase Manhattan Bank in New York, and the Metropolitan Life Insurance Company. Mr. Kappel's high sense of loyalty, his dynamic leadership, his fairness and considerate judgment of the individual man, have earned for him the profound respect of all.



Frederick R. Kappel, President, American Telephone and Telegraph Company

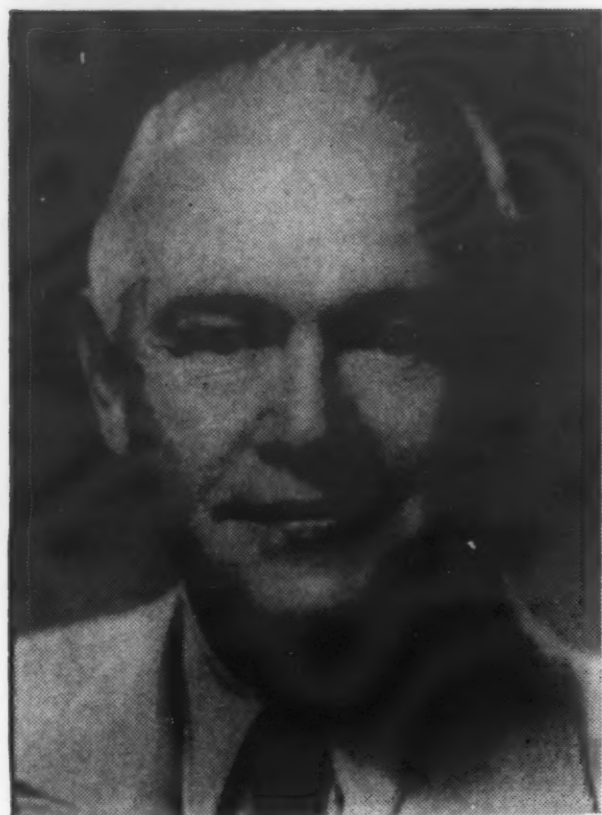


INDUSTRIAL LUNCHEON SPEAKER



Major General Kenneth P. Bergquist, USAF, Commander, Electronic Systems Division, Air Force Systems Command, Hanscom Field

Major General Kenneth Bergquist was graduated in 1935 from the U. S. Military Academy with a commission as a second lieutenant in the U. S. Field Artillery, and then detailed to the Air Corps as a flight student. He received his pilot's wings in 1936 from the Advanced Flying School at Kelly Field. General Bergquist's military career has since been distinguished with highly responsible assignments, meritoriously served. His most recent duties have included Commander of the Air Defense Systems Integration Division, Hanscom Field, Bedford, Massachusetts, and Commander, Air Force Command and Control Development Division, Air Research and Development Command, Hanscom Field. General Bergquist assumed his present command on April 1, 1961. He is a 1950 graduate of the National War College and the recipient of many foreign and U. S. decorations and medals. General Bergquist has served with distinction on four separate occasions in the Nation's Capital—the last time in 1957 when he became Assistant Deputy Chief of Staff for Operations.



*New Horizons
With Time and Distance
in Full Retreat*

W. J. BAIRD
General Manager and Editor

AT THIS MOST explosive moment in history most of us share an identical image of our present world—a world where the possibilities of a hot war are never absent, where military, ideological and psychological tensions create crises requiring decisions of great wisdom. At no time in our nation's history have communications and electronics and the power of the human voice been more important to our national security.

In recent decades we have seen the world tied together on a split second basis by communications. New horizons in scientific achievements have put time and distance in full retreat while increasing the tempo and excitement of our electronic frontiers. Tomorrow's modern communications not only will cover the surface of the earth but encompass it as well. From a standpoint of terrestrial coverage, there is little more that can be expected. But, from a performance viewpoint, new forms of equipment with new operating methods will emerge to provide easier access to every remote point.

Since World War II, the pulsating rate of electronic progress has led to a series of outstanding evolutions in today's military weapons, ICBM's, IRBM's, electronic countermeasures, computers, new radar techniques, instrumentation and reconnaissance satellites are but a few of these inno-

ventions. Their impact on our welfare has been both catastrophic and beneficial.

Somehow electronics seem to provide the means of performing all sorts of things designed for war purposes. We have gone from miniaturization to micro-miniaturization; we have compressed the assembly of electronic parts to the order of several million per cubic foot, we have progressed from the art of controlling machines to the electronic brain to store, receive, evaluate and transmit data; and we have moved from missiles to satellites and space probes to provide new methods of communications and seek answers in the field of photography, meteorology, reconnaissance and geodesy. Of primary concern, as we race forward in a competitive sense is our apparent disregard to stop long enough to finalize our thinking on definite objectives. Do we definitely know what hardware or what products we want to the exclusion of others and in what quantities and for how much? It may well be that we are putting our eggs in too many baskets.

Certainly, communications and electronics have increased the command and control capabilities of our services. Surveillance drones and satellites have provided vital information more rapidly for command decision, proving beyond a doubt

that electronic technology is the outstanding factor in the research and development equation of weapon systems. In all aspects, electronics is the keystone of our military capability. With this, there can be no argument. But, the mind of man that is capable of devising the means to exterminate human life from earth is capable also of perfecting the necessary scientific safeguards to provide for the future safety and security of mankind.

It is quite likely that the time has arrived when science and engineering technology should travel on a parallel course (peace and war preparedness). Technology alone will never maintain world security but on the other hand world security will never be maintained until new technologies are created to provide simultaneously essential elements of information for all nations. The problem here, then, is one of decision. Has the art of electronics and communications and systems technology progressed to the point of providing this technical intelligence base to detect, inspect, monitor and stop any future attempt to mobilize nuclear, missile, traditional, bacteriological or future fantastic electronic war? This, perhaps, is a most challenging subject at a time when science and engineering are striving to fashion new breakthroughs in communications, electronics and space.

The Association and SIGNAL Magazine wish to express their sincere thanks and appreciation to all those taking part in the 1961 Armed Forces Communications and Electronics Association Convention and Exhibition. We are sure that the leaders of industry and the military services, the members of the Association and their friends will be richly rewarded through the contributions by our exhibitors and advertisers.

quotations from service communicators

The combination of international unrest and tremendously improved fire-power and mobility makes anything less than a global capability in communications unthinkable. A military communications satellite system must be an integral part of this vital capability.



RAdm. Frank Virden, USN
Assistant Chief of Naval Operations
(Communications)/Director, Naval
Communications

Where we stand today with respect to military communications systems is the product of the persistent, imaginative and sound technical endeavor of a military and industrial partnership. Implied in the challenge of tomorrow is the problem of defining our future communications systems objectives and identifying the most promising avenues of endeavor to meet them.



Maj. Gen. R. T. Nelson
Chief Signal Officer, USA

Electrical communications requirements for command and control of U. S. naval forces moving continuously throughout the waters of the world have expanded enormously in the last decade and continue to do so. This is a restless time, full of movement, imposing the most comprehensive demands on wireless communications. The search for new techniques and applications in radio is ceaseless.



Maj. Gen. Harold W. Grant, USAF
Director, Communications-Electronics

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AFCEA NATIONAL CONVENTION PROGRAM

- 100 Exhibitors
- 200 Exhibit Units



- 4 Panel Discussions
- 6 Important Social Events

PROGRAM OF EVENTS

Panels and Social Events will be held in the Sheraton-Park Hotel.

Monday, June 5th

Executive Committee Meeting 5:30 PM

Board of Directors Meeting 6:15 PM

Tuesday, June 6th

- 9:30 AM—Opening Ceremony
Entrance to Sheraton Hall
- 10:00 AM—Panel Discussion — Present
to Media and Future Concepts
of World-Wide Communica-
tions.
Moderator: Dr. H. Busignies
International Telephone &
Telegraph Corporation
(To be introduced by RAdm.
F. R. Furth, V.P. ITT Corp.)
Sheraton Hall
- 12:30 PM—Keynote Luncheon
Speaker: The Honorable
Richard S. Morse
Assistant Secretary of
the Army (R&D)
Cotillion Room
- 2:00 PM—Regional Vice Presidents and
Chapter Presidents Meeting
Continental Room
- 4:00 PM—Council and Directors Meeting
Continental Room
- 6:30 PM—Reception
Continental Room
- 7:30 PM—Buffet and Floor Show
Sheraton Hall
- Exhibits: 11:30 AM—7:25 PM

Wednesday, June 7th

- 9:30 AM—Panel Discussion—
to New Frontiers in
Reliable Communications
Moderator: Dr. Herbert
Trotter, Jr.
General Telephone and
Electronics Laboratories, Inc.
(To be introduced by RAdm.
F. J. Bell, V.P. GT&E Corp.)
Sheraton Hall
- 2:00 PM—Panel Discussion—Scientific
Applications of Electronics in
Photography
Moderator: RAdm. Robert S.
Quackenbush, Engineering
Div., Polaroid Corp.
(To be introduced by K. B.
Lewis, Eastman Kodak Co.)
Sheraton Hall
- 6:30 PM—Reception
Continental Room
- 7:30 PM—Banquet
Speaker: Frederick R. Kappel
President, American Tele-
phone and Telegraph Co.
Sheraton Hall
- Exhibits: 11:30 AM—7:25 PM

Thursday, June 8th

- 9:30 AM—Panel Discussion—
to Recent Developments in
Government Contracts and
Procurement Procedures
by Federal Bar Association of
Washington, D. C.
Moderator: E. K. Gubin
Federal Bar Association
(To be introduced by Frank W.
Wozencraft, Attorney at Law.)
Sheraton Hall
- 12:30 PM—Industrial Luncheon
Speaker: Major General
Kenneth P. Bergquist
Commander, Electronic Sys-
tems Division, Air Force Sys-
tems Command, Hanscom
Field, Massachusetts
Cotillion Room
- 4:30 PM—Drawing for four radios
AFCEA Information Desk
(Be sure exhibit cards are prop-
erly punched and deposited prior
to Drawing.)
- Exhibits: 11:30 AM—4:30 PM

For The Ladies

The ladies are invited to assemble in the Madison Room each morning at 9:00 AM for coffee.



Mrs. Dorothea Ostberg
Chairman, Ladies Activities

- Tuesday —Morning Coffee, Madison Room 9:00 AM
Keynote Luncheon 12:30 PM
Reception 6:30 PM
Buffet and Floor Show 7:30 PM
- Wednesday—Morning Coffee, Madison Room 9:00 AM
Luncheon and Fashion Show 12 Noon
Reception 6:30 PM
Banquet 7:30 PM
- Thursday —Morning Coffee, Madison Room 9:00 AM
Industrial Luncheon 12:30 PM

Ample time has been provided this year for those ladies wishing to shop.

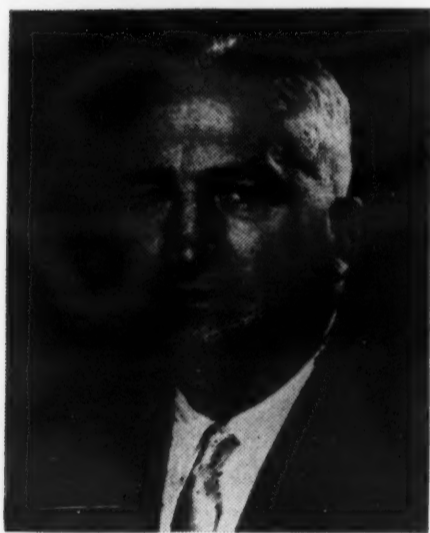
FOR LISTING OF EXHIBITS SEE PAGES 13 AND 14



DR. HENRI BUSIGNIES
Vice President, General Technical Director, International Telephone & Telegraph Corporation



DR. HERBERT TROTTER, JR.
President, General Telephone & Electronics Laboratories, Inc.



RADM. ROBERT S. QUACKENBUSH,
USN (RET.)
Engineering Div., Polaroid Corp.



E. K. GUBIN
Chairman, Trade Association Liaison Subcommittee, FBA Committee on Government Contracts and Procurement

P a n e l M o d e r a t o r s

Tuesday, June 6

10:00 A.M.—Present Media and Future Concepts of World-Wide Communications

INTRODUCED BY RADM. F. R. FURTH, VICE PRESIDENT, ITT CORPORATION

PANEL MEMBERS:

L. A. deRosa, Vice-Pres., ITT Communications Systems Inc.; Kenneth Zitzman, Managing Director, International Standard Engineering, Inc.; R. L. Plouffe, Director, Digital Systems Lab.; W. Glomb and J. Granlund, Executive Engineers; L. Pollack, Assoc. Lab. Director, and W. Sichak, Director, Communications Systems, ITT Federal Laboratories.

Dr. Busignies received his early education and earned his degree in electrical engineering at the Institute Normal Electrotechniques, Paris, in 1926. He joined the ITT System in 1928 as an engineer with the Paris Laboratories. Since 1941, when he participated in the founding of ITT Laboratories, Dr. Busignies has played a major role in the growth of the corporation's activities. He became a technical director of the Laboratories in 1949, vice president and member of the management advisory board in 1953 and executive vice president in 1954. Prior to his present position, he served three and-a-half years as president of ITT Laboratories. Dr. Busignies holds more than 100 patents in the air navigation, radar and communication fields. He has received the U. S. Navy Certificate of Commendation and the Presidential Certificate of Merit in recognition of his outstanding contributions.

Wednesday, June 7

9:30 A.M.—New Frontiers in Reliable Communications

INTRODUCED BY RADM. F. J. BELL, VICE PRESIDENT, GT&E CORPORATION

PANEL MEMBERS:

Dr. Robert San Soucie, Manager Advanced Communications Lab., Amherst Laboratory; Allen Culbertson, Director of Engineering, Lenkurt Electric; Seymour Stein, Senior Scientist & Director of Communications Research, Applied Research Lab., Waltham Laboratories; and Dr. Allen L. Solomon, Manager, Chemistry Lab., Bayside Laboratories, GT&E Labs., Inc.

In addition to directing the scientific research activities of the Laboratories, Dr. Trotter is responsible for directing and coordinating the research and engineering activities of GT&E's manufacturing subsidiaries including Sylvania Electric Products Inc., Automatic Electric Co., Leich Electric Co., Lenkurt Electric Co., Inc., and others. Dr. Trotter was graduated from Hampden-Sydney College and received a Ph.D. in Physics from the University of Virginia. He has been awarded a Presidential Certificate of Merit for his role in the development of the proximity fuze. Dr. Trotter was a senior vice president of Sylvania before assuming his present position in January of 1960.

Wednesday, June 7

2:00 P.M.—Scientific Applications of Electronics in Photography

INTRODUCED BY K. B. LEWIS, EASTMAN KODAK, MANAGER, WASHINGTON OFFICE

PANEL MEMBERS:

Allan M. Erickson, Electronic Engineer, Naval Ordnance Laboratory; Robert Morris, Army Project Center; Pat Bradley, Vandenberg Air Force Base; and Donn L. Ockert, head of Instrumentation, Photogrammetry Inc.

Admiral Quackenbush was the first United States military officer to attend the British Photographic Interpretation School. He established and taught at the United States Naval Photographic Interpretation School. A graduate of the United States Naval Academy, Admiral Quackenbush served as Director of Photography at the Navy Department and was the Navy member of the Photographic and Survey Section of the Joint Chiefs of Staff. He is also a vice president of the American Society of Photogrammetry.

Thursday, June 8

9:30 A.M.—Recent Developments in Government Contracts and Procurement Procedures Stressing Electronics

INTRODUCED BY FRANK WOZENCRAFT, ATTORNEY AT LAW

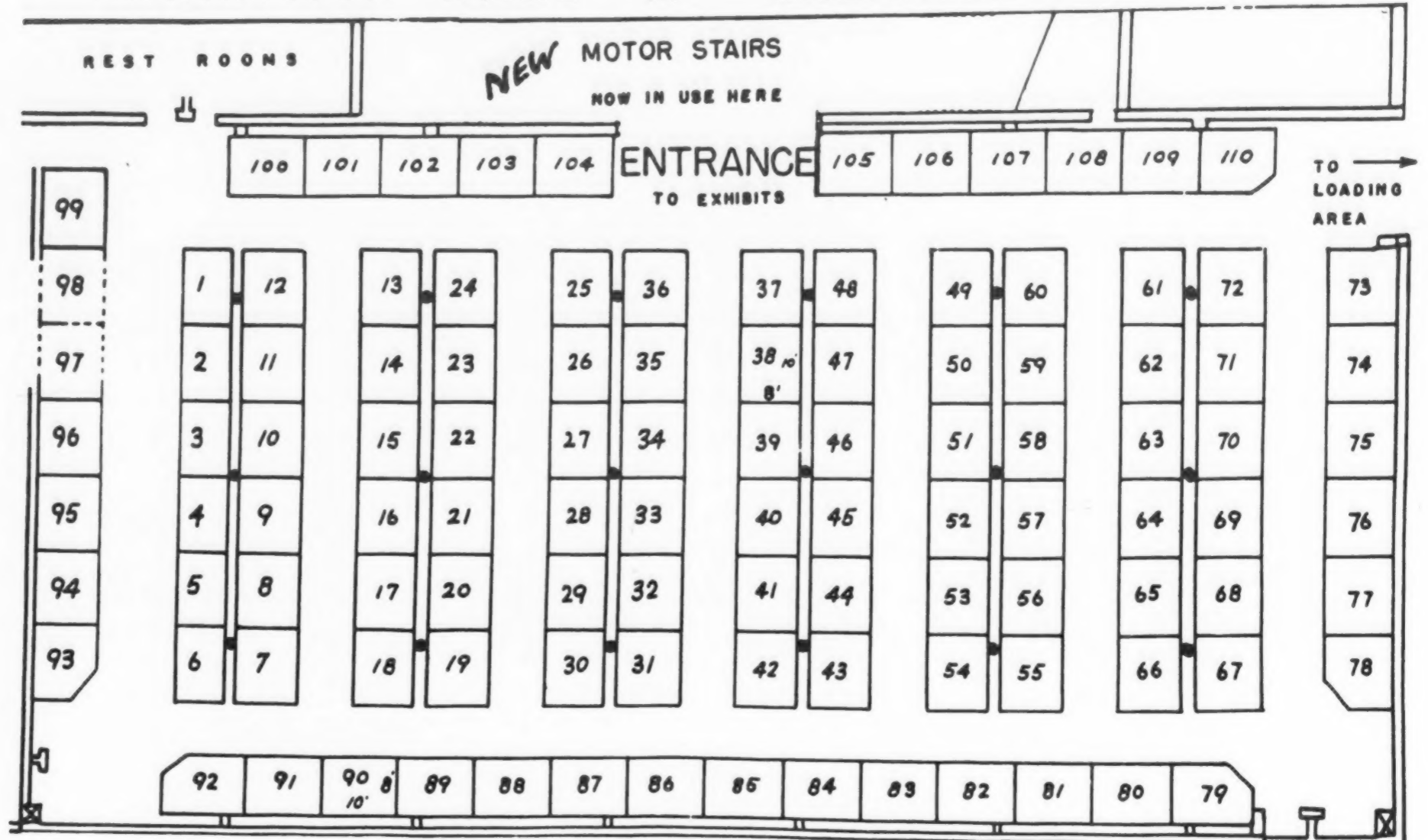
PANEL MEMBERS:

Louis Spector, Chairman, Army Panel, Armed Services Board of Contract Appeals, and Chairman, FBA Com. on Gov't. Contracts and Procurement; Gerritt Wesselink, Deputy General Counsel, Dept. of Air Force; John Phelan, Deputy General Counsel, Dept. of Navy; and John G. Gregg, General Counsel, Office of the Chief Signal Officer, Dept. of the Army.

Emil K. Gubin received a B.A. degree from the University of California in 1926 and an LL.B. from the same university in 1928. During 1959-1960 he served as Co-Chairman of the Federal Bar Association Committee on Government Contracts. He is presently a member of that committee as well as the D. C. Bar Committee on Public Contracts and the American Bar Association Committee on Public Contracts and Vice-Chairman of the D. C. Committee. Active in the Reserve Officers Association, Mr. Gubin is a member of the National Army Affairs Committee, ROA. He is the author of "How to Do Business Under the Marshall Plan" and "How to Finance Defense Contracts."

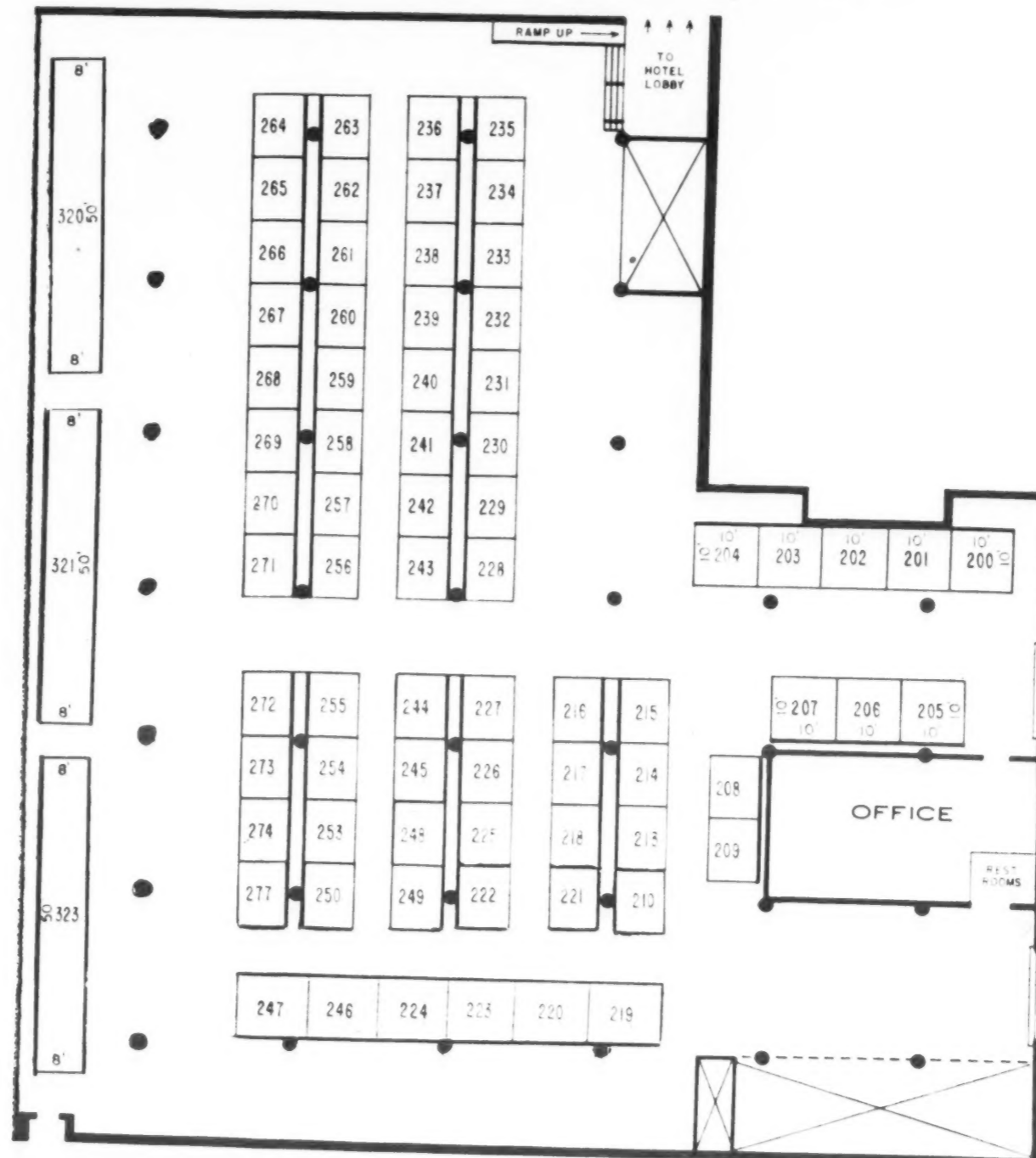
EXHIBIT LOCATIONS

EXHIBITION HALL IN SHERATON-PARK HOTEL



LOCATED DIRECTLY BENEATH BALLROOM

EXHIBITION HALL IN SHOREHAM HOTEL



AFCEA Show Exhibitors and Booth Numbers

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15th ANNUAL AFCEA CONVENTION EXHIBITS

EXHIBIT MANAGEMENT

WILLIAM C. COPP & ASSOCIATES

72 West 45th St., New York 36, N. Y. • Murray Hill 2-6606

100 Exhibitors



200 Exhibit Units



Denotes AFCEA Group Member

Booths 1-110, Sheraton-Park

Booths 200-323, Shoreham

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AFCEA-SIGNAL Magazine
Booth B in Shoreham
1624 Eye St., NW, Washington 6, D. C.

Adler Electronics, Inc.
Shoreham outside area



1 LeFevre Lane, New Rochelle, N. Y.
• Emanuel Strunin, Alfred Strogoff, Alwyn L. Carty, Jr., Charles Johnson, Walter Bieber, Merwyn Shopenn, Cyril Durnovo, Harold Kaye, H. W. Teschmacher, John Ward, William Mannel

AN/TSC-20 Compact Air-transportable, communications central provided multi-channel voice and teletype circuits over a 2,500 mile range. For use by the U. S. Army in limited war situations.

Alden Electronic & Impulse Recording Equipment Co., Inc., Booths #13, 14

Alden Research Center, Westboro, Mass.

• John M. Alden, G. F. Stafford, William L. Alden

Alden High Speed Facsimile System for handling 2 letter per minute of copy any size and length. Tape conversion to and from conventional 4 minute per letter transmission speed. System thereby compatible to all existing Alden facsimile scanning and recording equipment now in the field.



High Speed Alden Facsimile transmission of all size original copy

All Products Co., Booth #250
See: Antenna Products Co.

Alpha Corp., Booths #228, 229, 230, 231, 232, 233, 234, 235
See: Collins Radio Co.

American Machine & Foundry Co., Government Products Group
Booths #269, 270, 271



261 Madison Ave., New York 16, N. Y.
• William Hurley, C. H. Bell, G. R. Thompson, David Bauer

Coaxial Cross Bar Switching Device. Precision Instrument Mounts, Portable and fixed Radar Equipment and Devices. Communications lighting and control equipment.

American Telephone & Telegraph Co.
Booths #1, 2, 3, 4, 9, 10, 11, 12, 25, 26

See: Bell Telephone System
Teletype Corp.

Andrew Corp., Booth #69



P. O. Box 807, Chicago 42, Ill.
• Lawrence Krahe, Harold Dellets, C. Robert Lane, Robert C. Bickel

Heliac flexible air dielectric cable; microwave and telemetry antennas; HF log periodic antennas; transmission lines and waveguides; Hubloc antennas; large parabolic antennas featuring high surface accuracy, simple to install.

Antenna Products Co., Div. of All Products Co., Booth #250

P. O. Box 110, Mineral Wells, Tex.
• Samuel M. King, John H. Dunlavy, Jr., Kenneth H. Read

Total capability to develop, design, and manufacture antenna systems for communications, telemetry, surveillance from VLF through VHF. Featuring "Talking Bird," highly portable, Log Periodic Antenna of unique design.

Antenna Systems, Inc., Booth #227

349 Lincoln St., Hingham, Mass.
• A. K. Fowler, C. W. Creaser, Jr., J. Richard

Mobile 30' antenna for scatter and tactical applications; waveguide components WR 430 to WR 2300; scatter antennas 30' and 60'; tracking antenna for requirements through X-band.

Atlantic Research Corp., Electromechanical Div., Booth #70

Shirley Highway at Edsall Road, Alexandria, Va.

• C. M. Gray, G. C. Pierce, Frank Baxter, C. F. Swanson, James Britt
Telegraph test equipment: pocket distortion measuring sets, DMS-1A and DMS-1A-1; station automatic test cord; telegraph signal quality monitors; high-speed data pulse measuring sets; test room distortion analyzers.



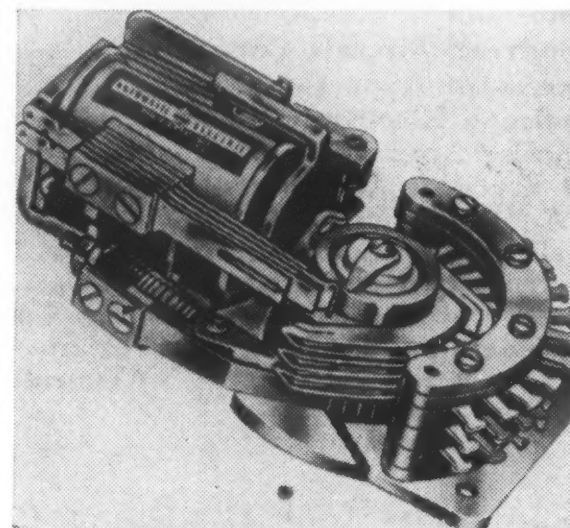
Distortion Measuring Set Model DMS-1A-1

Automatic Electric Sales Corp., subsidiary of General Telephone & Electronics Corp., Booth #42



400 N. Wolf Road, Northlake, Ill.
• E. E. McCorkle, C. I. Wright, J. P. Costello, H. B. Bittner, D. W. Tidd

Telephone communication systems. Relays, rotary stepping switches, sub-assemblies and control systems.



AE's Type 44, Rotary Stepping Switch

Automatic Telephone & Electric Co. Ltd., Export Dept. Booths #59, 60



Strowger House, 8 Arundel St., London, W. C. 2, England
• *H. R. A. Wood, W. H. Carsbury, C. H. Wolff, A. P. Clark*

Card mounted transistorized transportable multiplexing equipment—R3A, type CM, for radio links. High speed data transmission equipment—tape to tape. Auto-numbering telegraph tape reading transmitter T.A.A., and electronic distributor. 24-channel carrier equipment, type CM.

Avnet Electronics Corp. Booths #206, 207

70 State St., Westbury, Long Island, N. Y.

• *Joseph Walsh, Carroll O'Mack, Charles Merz, George Contino, Jack Reynolds*

C. P. Clare Relay systems; Bendix Scintilla Connectors; Sperry, U. S. Semcor Semiconductors; Greomar; Microdot Connectors; Robertson Splice Cases; T.I.C. Precision Trimmers; King Capacitors.

Bell Telephone System, American Telephone & Telegraph Co.

Booths #1, 2, 3, 4, 9, 10, 11, 12



195 Broadway, New York 7, N. Y.

• *Harold E. Quann, A. Greenwood, J. Toleman, W. R. Hyatt*

Bell System world-wide and proposed satellite communications systems, unique networks serving the Armed Forces, and the latest inventions and developments in communications of military interest.

The Bendix Corp., Bendix-Pacific Div. Booth #75

11600 Sherman Way, N. Hollywood, Calif.

• *W. Gottschall, J. Harkness, R. Nicol, W. Knapp, J. Poliak*

Digital data handling equipment, high resolution helicopter radar systems, terrain avoidance systems, missile guidance systems, ECCM devices, telemetry systems and components, space vehicle tracking and guidance, radar altimeters, radar direction finding equipment, training devices, field support.

Capitol Radio Engineering Institute Booth #45



3224 16th St., N.W., Washington 10, D. C.

• *Karl O. Bathke, H. E. McCallick, L. M. Upchurch, C. P. Young, Joseph Martinez*

New and expanded programs in advanced Electronic Engineering Technology. Aeronautical and Navigational, Communications, Television, Automation and Industrial Electronics Engineering Technology; Management, Advanced Mathematics and Nuclear Engineering Technology.

Chassis-Trak, Inc. Booth #243

525 S. Webster Ave., Indianapolis 19, Ind.

• *Larry Vaughn, John C. Davis, Gene Rosen, Cora Rosen*

Military type relay racks; slides; modular chassis; panels and hardware.

Chesapeake & Potomac Telephone Co. See: Bell Telephone System

Cleveland Institute of Electronics Booth #217

1776 East 17th St., Cleveland 14, Ohio

• *Gerald O. Allen, Ralph J. Schmotzer*

Electronics training programs designed for industry and the Armed Forces, covering automation, instrumentation, industrial electronics, computers, radar, telemetry, FCC license preparation, pulse circuitry, aviation electronics, servomechanisms and communications.

Collins Radio Co.

Booths #228, 229, 230, 231, 232, 233, 234, 235 and outside area



Texas Div., Dallas, Tex.

Cedar Rapids Div., Cedar Rapids, Ia.

Alpha Corp., subsidiary, Dallas, Tex.

Western Div., Newport Beach, Calif.

• *C. P. Glade, R. P. Dutton, D. E. Busse, E. G. Abercrombie, J. C. Culp*

Specializing in radio communication and navigation for ground, airborne and space applications. Facilities for design, manufacture, installation and management of complete systems.



Commonwealth of Puerto Rico, Economic Development Administration Booth #240

666 Fifth Ave., New York 19, N. Y.

• *R. L. White, J. Morales, A. Higuera, P. Switz, E. Ellenis*

Industrial Development of Puerto Rico. Puerto Rico is very proud of its rapidly expanding electronic industry. Our exhibit tells the electronic industry the advantages that Puerto Rico can offer to expanding firms.



Puerto Rico's Growing Electronics Industry

Comptometer Corp., Electrowriter Sales Div. Booths #73, 74



5600 Jarvis Ave., Chicago 48, Ill.

• *Ralph S. Perers, James G. Johnson, Robert B. Grimshaw, Robert W. Davison, Roger W. Stoner*

Electrowriter written communication systems. Electrowriter instruments used with telephone facilities for alternate voice/write service. Electrowriter instruments used with radio circuits. Electrowriter instruments with push-button and dial switching systems.

Conference Book Service Booth #6

201 S. Washington St., Alexandria, Va.

• *W. D. Ready, C. C. Cameron*

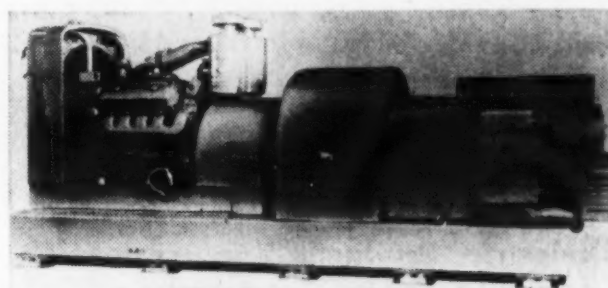
A special collection of books on electronics and engineering.

Consolidated Diesel Electric Corp., Power Equipment Div. Booth #65

880 Canal St., Stamford, Conn.

• *Frank M. Cesario, Jerry Friedman, John Kazan*

Uninterrupted power supply which, in the event of normal power failure, provides continuing power with no interruption whatsoever and provides full voltage restoration in 1.5 milliseconds.



Uninterrupted Power Supply

Continental Electronics Manufacturing Co., subsidiary of Ling-Temco Electronics, Inc. Booths #248, 249

4212 S. Buckner Blvd., Dallas 27, Tex.

• *Thomas B. Moseley, W. D. Mitchell, Vernon Collins, J. K. Biggs*

Panoramic display of super power projects by Continental, including model and filmstrip of the 2,000,000 watt VLF installation for the Navy at Cutler, Maine.

Contronics, Inc. Booth #258

37 Leon St., Boston 15, Mass.

• *Phil W. Beck, William C. Curry, N. E. Berg, Fred Israel, Michael Matthews*

Fully automatic diode tester capable of automatically handling and testing taped components including JAN 256 and stored charge measurements. World's highest speed analog-to-digital converter.



Developmental Engineering Corp.
Booth #56



1000 Connecticut Ave., N.W.,
Washington 6, D. C.
• T. E. Harper, L. E. Rawls,
W. S. Alberts, R. E. Ankers, A. C.
Sayland

Communication Moon Relay system;
tapered aperture horn antenna
(TAHA); balun transformer; Navy
VLF antenna, Cutler, Me. Pioneers in
the field of substrata communications
and the development of hardened an-
tenna systems.

**A. B. Dick Co., Videograph Market-
ing Div.** Booths #219, 220

5700 West Touhy Ave., Chicago 48, Ill.
• E. A. Freiburger, Wes Summerfield
Videograph digital display console—
provides instantaneous CRT display of
up to 190 characters upon inquiry into
random-access type memory. Self-con-
tained character generator converts
binary digital input to readable alpha-
numerics.

Dictaphone Corp. Booth #58



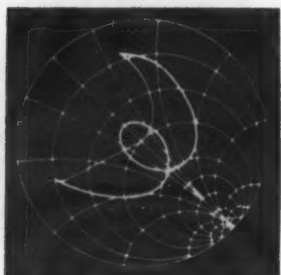
2208 Wisconsin Ave., Washing-
ton, D. C.
• L. A. Engel, W. B. Sturtevant,
T. Y. Waite, A. R. Wilson, J. G. Leth-
bridge

A.I.M.O., Dictatape, Dictalog, Dicta-
cord, Dictet, Dictaphone Time Master,
Datafax.

**Dielectric Products Engineering Co.,
Inc.** Booths #95, 96

Raymond, Maine
• Joseph Kinney, Jr., Edward Shively,
Wilfred Beauregard, Richard E. Fiore,
Myron Whitney

Automatic 10-3000 mc/s Smith Chart
Plotters; FM & Base Station antennas;
transmission line dehydrators, RF
switches, other RF controlling and
directing devices, rigid transmission
line, and other microwave and commu-
nication devices.



Dynamics Corporation of America
Booths #66, 67, 68

See: Radio Engineering Laboratories,
Inc.
Reeves Instrument Corp.

Economic Development Administration
Booth #240

See: Commonwealth of Puerto Rico

**Fairchild Camera and Instrument
Corp., Defense Products Div.**

Booths #256, 257



300 Robbins Lane, Syosset, N. Y.
• Stewart T. Pardee, John S.
Auld, Kenneth Wydler, John
W. Bjorkman, Paul J. Larsen

Reconnaissance and mapping systems;
data acquisition, processing and dis-
play systems; communications, military
television and special radar systems;
electronic control and ground support
equipment; programming, fuzing, and
safety and arming devices.



DEFENSE PRODUCTS DIVISION

**Fairchild Camera & Instrument Corp.,
Industrial Products Div.** Booth #214



580 Midland Ave., Yonkers,
N. Y.
• Herbert M. Oshan, John W.
Stein, G. J. Morio, R. G. Hennessey,
C. J. Sass

A new service of facsimile transmitting
and recording equipment to be shown
in public for the first time. Features:
continuous feed, flat bed scanning,
completely transistorized amplifier sys-
tem, whirlygig optical system, new
rapid runup feature and selective in-
dexing.

**Fairchild Publications, Inc., Electronic
News** Booth #205

7 East 12th St., New York 3, N. Y.
• Dan Newman, Samuel M. Deitch,
Jack Tisch, Henry Friedman, Doug
Jeppe

Electronic News—weekly publication
covering all facets of the electronics
industry.

**Federal Systems Div., International
Business Machines Corp.**

Booths #264, 265, 266, 267
See: International Business Machines
Corp.

**Filtron Co., Inc., Systems Engineering
Div.** Booth #238

131-15 Fowler Ave., Flushing 55, N. Y.
• Sam Perry, Bruce Burnett, Ed Dar-
nall, Myron Whitney, John Baker

Overall responsibility for Radiation
Frequency Interference Analysis, Meas-
urements and Control on Missiles, Com-
munications, Electronics Reconnaiss-
ance and Weapons Systems, RFI Anal-
ysis for Site selection. Consultation,
Testing and Systems Engineering for
Military RFI specifications. Electro-
magnetic Radiation Meter. Attenu-
Suit®. RF Radiation Protective Suit.



Technician wearing Attenu-Suit® measuring
RF radiation fields with Filtron Electro-Mag-
netic Radiation Meter

Foto-Video Electronics Inc.
Booth #277

36 Commerce Road, Cedar Grove, N. J.
• Albert J. Baracket, Jesse Dines, Don
Foyer, Angelo J. Dumont, Robert R.
Hamilton

Military and Industrial Closed Circuit
Television; Television Test Equipment;
Radar-TV Keyed Composite Video Sig-
nal Generator; Regulated Power Sup-
ply System and Mil-Spec Regulated
Power Supplies.

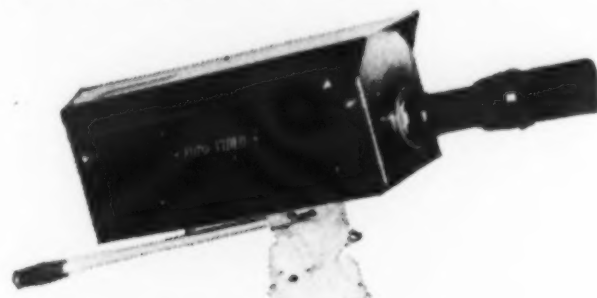


Image Orthicon Foto-Video TV Camera

GP Engineering Services, Inc.
Booth #202



220 Church St., New York 13,
N. Y.
• C. Behrens, Milton Wood,
Ivan von Sohonyay, L. Lucas

Engineering writing, editing and parts
cataloguing; Contract and field engi-
neering; Typing and composition; Cre-
ative art, retouching and rendering; In-
dustrial photography and slide presenta-
tion; Lithographic negative preparation
and offset printing.



**Gates Radio Company, subsidiary of
Harris-Intertype Corp.** Booth #64

123 Hampshire, Quincy, Ill.
• Robert Kuhl, W. W. Warren, Walton
T. Ayer

2.5 KW PEP Linear Amplifier which
covers entire 2 to 30 megacycle range,
uses only 4 tuning controls; amplifier
can be used in single sideband; com-
pletely self-contained in 24 x 24 x 60
inch cabinet. Transistor Audio Ampli-
fier System.

General Communication Co.

Booth #222

677 Beacon St., Boston 15, Mass.

• Clinton Roche, William Simonds, Ralph Goodwin, Carl Whittier, William Burt

Tunable triode and klystron oscillator cavities, fixed-frequency wavemeters, dial wavemeters, waveguide-beyond-cut-off attenuators, coaxial switches and relays, precision pulse-power calibrator with interchangeable RF head.



General Dynamics/Electronics, Div. of General Dynamics Corp.

Booths #89, 90, 91, 92

100 Carlson Rd., Rochester 3, N. Y.

• David S. Cook, Thomas S. Leitch, P. Eugene Laliberte, Henry C. Sheve, Payne B. Johnson, Donald F. Jamieson, L. H. Orpin

"Dynalogic" Electronic Switching, C-Band Transponder, High-Speed Data Transmission System, Charactron® shaped beam tubes, Project Mercury Operations Room model, Vibration Analyzer and Monitor.

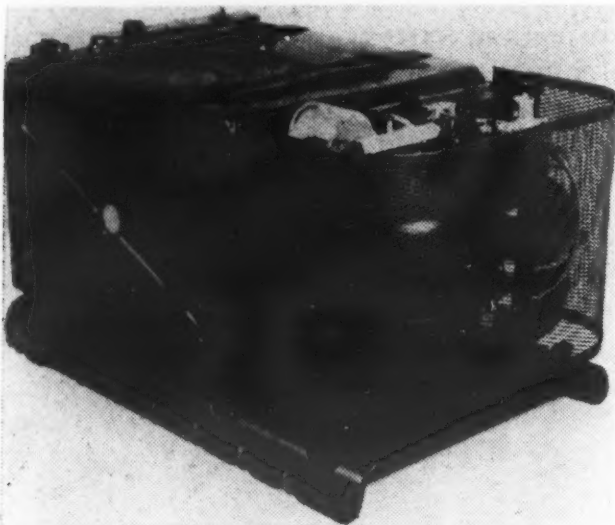
General Electric Co., Aircraft Accessory Turbine Dept.

Booth #22

950 Western Ave., West Lynn 3, Mass.

• Adrian E. Van Dorpe, John A. Kelly, Jr., Soeren S. Nielsen, James W. Babcock

Direct energy conversion equipment: Fuel cells and thermoelectric generators (portable power sources for communications and electronics equipment).



GE Portable Fuel Cell Power Source

General Electric Co., Heavy Military Electronics Dept.

Booths #23, 24

Syracuse, N. Y.

• N. R. Bibko, C. E. Beard, W. F. Squires, F. R. Prentice, M. S. Chacona

Design, development, manufacture and field support of radar, sonar, missile guidance and control, computer, data handling and display, communications and countermeasures equipments for

application in ground warfare, undersea warfare, air defense, missile defense and space exploration.



AN/TPQ-10, New helicopter-transportable, high accuracy control radar for precision air support

General Precision, Inc., subsidiary of General Precision Equipment Corp.

Booths #47, 48

50 Prospect Ave., Tarrytown, N. Y.

• A. F. Brundage, N. Wicks, W. Weihe, G. Stancliff, Col. McCoy, P. Brady

Systems for Navigation, Guidance and Control; Computer Technology; Detection, Tracking, Acquisition and Fire Control Simulation and Logistic Support.

General Precision, Inc., GPL Div.

Booth #46

63 Bedford Rd., Pleasantville, N. Y.

• A. Brundage, R. Bernstein, T. French, W. Novak

GPL High Resolution Television Equipment operating in conjunction with a new Autofocal Machine permits an operator to examine microfilm or micro-components with a greater range of magnification than ever before obtainable at remote viewing points separate from the file by many hundreds of feet or several miles.

General Telephone and Electronics Corp.

Booths #37, 38, 39, 40, 41, 42, 93

See: Automatic Electric Sales Corp.

Lenkurt Electric Co.

Sylvania Electronic Systems Div.

Sylvania Electronic Tubes Div.

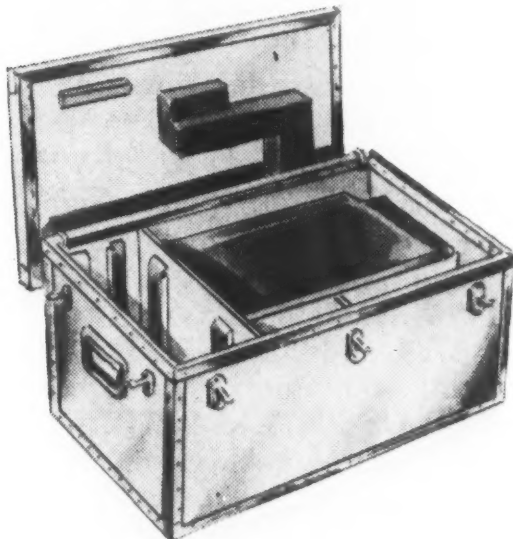
Goldsman

Booth #259

1328-34 North 4th St., Philadelphia 22, Pa.

• Ronald Goldsman, Al Goldsman, Richard H. Sager, Robert I. Galane, Chester A. Milewski

Transit Cases, Carrying Cases, Instrument Cases and Tool Chests.



Harris-Intertype Corp.

Booth #64

See: Gates Radio Co.

Hoffman Electronics Corp., Military Products Div.

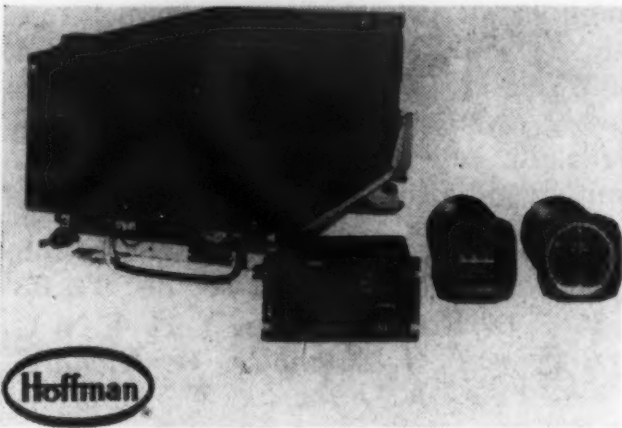
Booths #31, 32



3740 S. Grand Ave., Los Angeles 7, Calif.

• John O'Brien, J. D. Frye, J. W. Jones, J. Senkow, H. P. Briggs

The Hoffman exhibit will display and demonstrate TACAN AN/ARN-21C air Navigation equipment, the first major electronic equipment to be built on a production basis which fully meets AGREE standards. Also, the new TACAN "65" family will be unveiled.



TACAN AN/ARN-21C air navigation equipment

Hughes Aircraft Co., Microwave Tube, Ground Systems and Communications Div.

Booths #253, 254, 255



Florence & Teale Sts., Culver City, Calif.

• F. R. Del Rio, R. T. Plummer, J. C. Proctor, W. M. McHugh, J. R. Juncker

Traveling Wave Tubes, Backward Wave Oscillators, Ball Tracking Devices, Digikey Demonstration, HC-150 HF SSB Diversity Receiver, HC-150 Airborne HF Transceiver.

I. D. Precision Components Corp.

Booth #241



89-25 Van Wyck Expressway, Jamaica 35, N. Y.

• Walter A. Kirsch, Bernard Meyers, Richard Meyers, Michael Meyers

Manufacturers of miniature precision gear train mechanisms to meet military specifications and requirements of aircraft instrument and missile manufacturers. Pioneers and producers of a standard line of miniature precision gearheads and speed reducers. Have your watch checked for accuracy at our booth.

ITA Electronics Corp.

Industrial and Government Div.

Booths #203, 204

130 E. Baltimore Ave., Lansdowne, Pa.

• Eliot S. Baker, Bernard Wise, Joseph Roberts, R. Paul Comstock, Jr., Joseph Novik

AM, FM & HF Transmitter; High Power Baluns; Audio Consoles; Automatic Programming Equipment.

Institute of Radio Engineers
Booth A in Shoreham
1 East 79th St., New York 21,
N. Y.

Instrument Specialties Co., Inc.
Booth #221

244 Bergen Blvd., Little Falls, N. J.
• J. H. Baker, J. McLean, J. Pryor
Beryllium Copper Products.

**International Business Machines Corp.,
Federal Systems Div.**

Booths #264, 265, 266, 267, 268
326 East Montgomery Ave.,
Rockville, Md.

• D. E. Knight, J. J. Farley, J. V. Sterling, J. Zimmerman, H. Thomas
Informer—mobile, solid-state, information-handling system with real-time storage and retrieval. Data acquisition and display, communications data processing, systems development and management, research, engineering production, installation and field support.

International Telephone & Telegraph Corp. Booths #83, 84, 85, 86, 87, 88

67 Broad St., New York 4, N. Y.
• T. J. Connolly, G. Richardson, F. Fucuchi, W. Caprata, I. Sattim

Global and Space Communication Systems, Equipments and Components.

Jerrold Electronics Corp., Government and Industrial Div. Booths #43, 44

15th and Lehigh Sts., Philadelphia 32, Pa.

• Jerry Hastings, Bert Wolf, Harry Jackson, Charles Lauer, Joseph Rosenberry, Lee Druckman, Larry Torn

Demonstration of Jerrold's complete closed-circuit TV system including new Jerrold microwave equipment, wide-band video modulators and demodulators together with standard distribution equipment.

Kahn Research Laboratories, Inc.
Booth #99

81 S. Bergen Pl., Freeport, N. Y.
• Leonard R. Kahn, Robert C. Rogers, Lloyd A. Ottenberg

Single-Sideband Transmitter Exciter Driver for driving high level high efficiency modulated transmitter to produce high powered independent side-band signals. SSB Receiving equipment. Voiceplex system for producing two voice channels in 3 kc bandwidth.



Kahn SSB Transmitter Adapter

Kleinschmidt, Div. of Smith-Corona Marchant, Inc. Booths #53, 54



Deerfield, Ill.
• Raymond Strimling, Nicholas Geiser, Robert Berube, Robert Vehe

Teletypewriter printers, reperforators and switching systems. High Speed Field Data, Printers, Punches and Readers. High speed tape printers and computer peripheral devices.

Lenkurt Electric Co., Inc.
Booths #37, 38



1105 County Rd., San Carlos, Calif.

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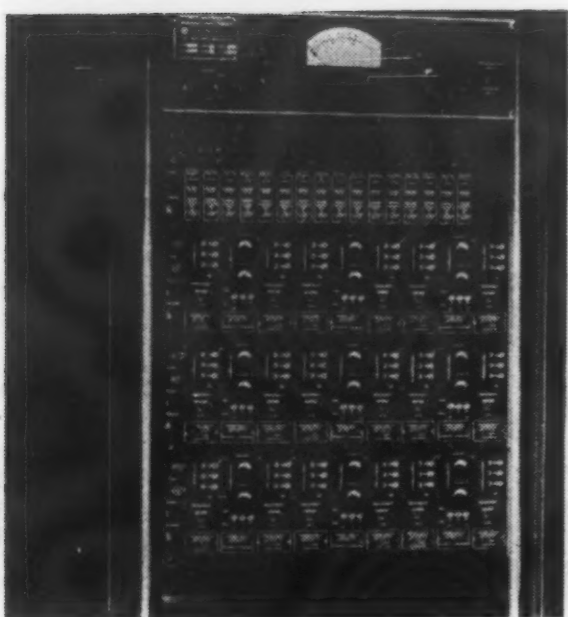
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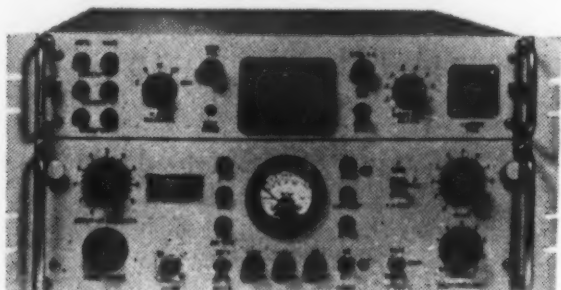
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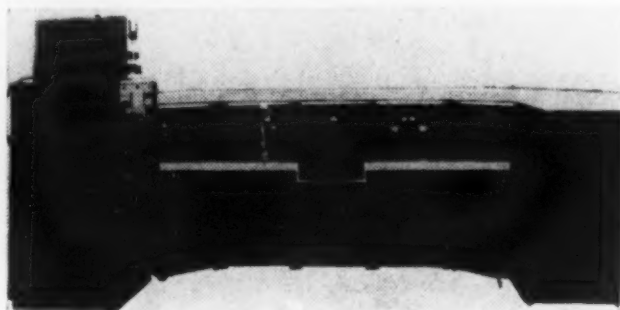
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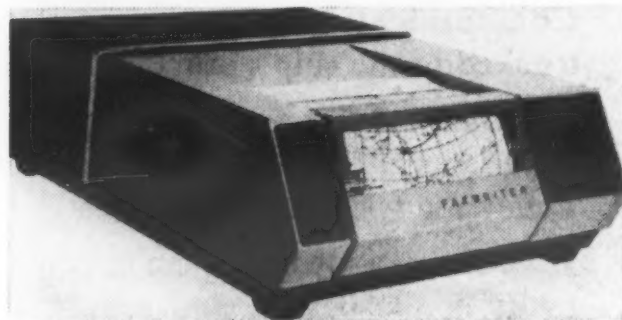
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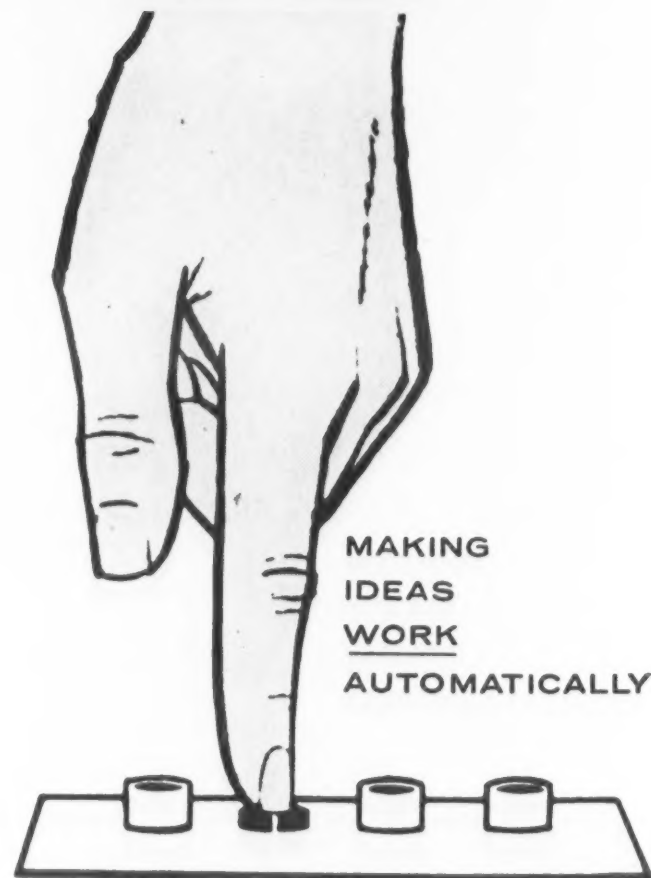
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This unique coupler — along with appropriate auxiliary equipment to form the complete plotter — eliminates the need to tie up highly skilled technical personnel during prolonged test routines that characterize slotted line measurements. As precise as it is versatile and easy to operate, the Plotter functions simply and quickly to deliver peak accuracies.

HOW IT WORKS

With Dielectric's Smith Chart Coupler, a sweep generator sweeps over the frequency band of the unknown load. A continuous trace of impedance versus frequency is displayed directly on the Smith Chart faceplate. This can be either a full

scale chart or one expanded to 1.5:1 VSWR. As adjustments are made, impedances change as does the corresponding trace. Since the Plotter is direct viewing, load changes can be observed immediately. When a permanent record is required, the oscilloscope trace may be directly photographed. Or, if preferred, an X-Y chart recorder may be used.

If you're a designer looking for a faster, easier way to obtain more accurate impedance and admittance measurements of diverse components such as antennas, filters, load resistors, transformers and other r-f networks, you'll find the Smith Chart Plotter one of your most essential tools.

SPECIFICATIONS (ALL MODELS)

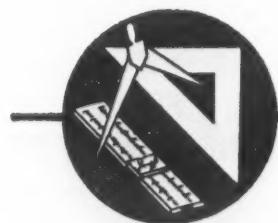
Nominal impedance.....	50 ohms
RF input voltage.....	0.2 volts, rms
Oscilloscope signal voltage (0.1 volt input to plotter)	40 millivolts x reflection coefficient
Accuracy of reflection coefficient measurement	
a. Amplitude.....	$\pm 5\%$ of reflection coefficient ± 0.01
b. Phase.....	± 3 degrees $\pm \arctan \left(\frac{.01}{\text{reflection coeff.}} \right)$
Sweep rate (maximum).....	60 sps
Spot rotation rate (maximum for full accuracy).....	1000 rev/sec
RF input and output terminals.....	Type N female
Oscilloscope signal terminals (balanced)	Type BNC female
Automatic level control terminals.....	Amphenol Series 27 female

For complete description and for details of operation of the Smith Chart Plotter, write for Bulletin 60-3.

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THE DEFENSE INDUSTRY AS A BUSINESS

by W. B. BERGEN
President
The Martin Company

FROM MY READING of financial journals and business commentaries, it seems that a lot of security analysts and financial writers labor under two basic misconceptions about the defense industry.

Misconception Number One is that the defense industry's business basically depends on what one security analyst has called "the whims of the Pentagon." The philosophy of this concept is that the military customers of our industry, when they have contracts to award, sit behind closed doors in their concrete sanctum and spin an imaginary roulette wheel to select the winners; if it stops on your number, you get the business—if it doesn't, you've been "given the business" in an entirely different way.

Misconception Number Two—one far more generally and seriously held—is that, when and if the threat of war should vanish and real peace "breaks out" in this very worried world, the defense industry automatically will be put out of business. It is to this concept that I wish to address myself first.

Obviously, a defense contractor such as The Martin Company, almost all of whose present business is in the development and production of weapon systems, would lose such business in the event of world disarmament. But there is more to it than that. If we have the skills and management capabilities we think we have, I believe our company—and other leading companies of the defense industry as well—could more than offset such a loss immediately with corresponding gains in the space business and in the business of devising and producing the complicated mechanisms of global surveillance that will be a vital corollary to keeping the peace once it has been achieved.



astronaut
prior to
training flight
on human
centrifuge

To me, this is almost axiomatic because companies like Martin, which were able to read the handwriting on the wall of the future years ago and got off to an early start on the transition from manned aircraft to missiles, already are probing the frontiers of space with intercontinental ballistic missiles and scientific exploration rockets. As a result, they now have their feet firmly planted on the threshold of the earth's virtually unknown celestial environment and are well prepared to take a leading part in man's forthcoming quests into space. And I firmly believe that if the United States ever should be able to lay down the heavy financial burden of its current weaponry insurance policy against war, it will make the same investment—and more—in what we call the peaceful exploration of space. It will do so, not because the so-called "munitions lobby" transforms itself into a "space lobby," but because our communist competition also has begun probing the unknown reaches of space, and because this is a race no nation, which hopes to retain its leadership in world affairs, dares abandon.

Importance of Space Leadership

Maintaining such leadership is of vital importance for two reasons. In hard, cold reality, these two reasons are Siamese twins, neither of which ever will be able to survive separation for long until we have achieved a far more ideal world than has yet been fashioned by mankind. One twin is scientific—the human race's undying urge to learn the secrets of its environment, earthly and celestial, and to use this knowledge in building an even better way of life. The other is military—and, up to now, it has been thrust upon us as a stark necessity for preserving and improving our way of life.

As yet, we have only a glimmering of the scientific

wonders and practical benefits that may be reaped from man's past and future ventures into space. But even this early glance has provided us with a powerful incentive to press on and on with our quests into and beyond the frontiers of space. It is only four years since the first man-made satellite went into orbit around the earth. Yet, only recently, the American Telephone and Telegraph Company asked the Government for permission to put up the first commercial satellite as a revolutionary new aid to speed world-wide communications. We do not know what we will find in space or what all its uses may be any more than Columbus knew what he would find when he sought a new and easier passage to India. But, like Columbus when he set sail from Spain, we are definitely on our way and determined to find out what lies beyond our present horizons.

Now, I would like to turn from the scientific twin to its military mate. All of us who are interested in averting another war can and should work to keep what our national leaders call the "peaceful exploration of space" truly peaceful. But wishful thinking will neither make our world peaceful nor keep it peaceful. The only way to insure continuing peace after disarmament is to assure ourselves a future stance in space as good as—or better than—that of other nations about whose sincerely peaceful intentions the really peace-loving part of the world still has sincere doubts.

New Vantage Point

Make no mistake about America's stake in space. It is as real and as vital to the free world's survival as is the need for our present-day arsenal to protect our current way of life from the very real threat of aggression under which the free world lives. Militarily, space is the "high ground" of tactical advantage sought by combat leaders since the first cliff-dwellers dropped rocks on enemies trying to storm their tribal strongholds. It is the vantage point later sought by the artillery commander, by the airplane pilot and now by the ballistic missile intent on dropping his weapons from the fringes of space. The conquest of space is not only desirable and inevitable scientifically, it is militarily imperative to the future peace of the world and hence to our survival.

Having disposed of this bugaboo about the uncertainty of the defense industry's future—to my satisfaction, at least, and hopefully, also, to yours—let us examine Misconception Number One. There are risks in being a Government-only contractor. Fundamentally, however, they are the same sort of risks that have to be faced in any business. We have to know our individual customers and their separate needs well, and we have to anticipate those needs as accurately and as far into the future as we can. Equally important is the ability to determine which of those needs Martin is best qualified to meet. If the defense contractor knows and handles his business well, he can rest assured the customer will always want to buy from him.

Defense business is big business. Our budget for defense is in the neighborhood of \$40 billion a year, and any change will be most likely upward. This is a big market. The contractor who knows that he can service a part of it better than anyone else can count on a stable or rising business. He can, to a great extent, control his own destiny. He should be able to earn a reasonable profit. He even has an advantage over the average business, for he is sheltered to some extent from the fluctuations of the business cycle.

There is one point that is essential to an understanding

of the defense business, because it represents a radical change from the days prior to, during, and immediately after World War II. In that conflict, our productive capacity gave us our great strength. We were able to supply a vast flow of tanks and trucks and artillery shells and planes. Now that capacity is no longer so important.

World War II was won, essentially, on *quantity* of weaponry. All present indications are that, if there is a World War III, it will be won by whichever side possesses *at the outset* weaponry of superior *quality*, though probably in very small quantities, indeed, compared to World War II's fleets of combat planes. For this reason, the nature of defense contractors' products today bears little resemblance to those of World War II.

There are fewer and fewer production lines of the type we had in the past. On the other hand, there is more and more research and development in a never-ending effort to turn out better and still better weapon systems. It is no longer sufficient to stay on a par with your potential enemy; the only safe way is to stay at least one step ahead of him to insure national survival. And, quite clearly, a second-best defense could be worse than no defense at all.

This means, first, that the weapon systems on which the nation currently is relying must have a high degree of *reliability*, plus the *capability* of doing the job they are supposed to do when they arrive on target.

Secondly, you must be improving both weapon capability and reliability even before they become operational—a fact explaining why Titan I actually is becoming obsolescent while still in the latter phases of its test program, because Titan II already is looming on the horizon. This is the defense industry's basic nature as it is today and as it promises to remain in the foreseeable future.

Planning For the Customer—And the Future

I said before that the defense contractor can control his own destiny. The way he controls his destiny is in the decisions he makes on what he is going to do—what he is going to study, what systems, or programs, he is going to bid on. By the time he is actually at work on the system or program, the Government, of course, has control.

Here is a point on which the defense contractor differs from the ordinary businessman. The businessman is out for the highest possible profit margin and the best return on his invested capital. Although these factors are also of major importance to the defense contractor, there are perhaps other factors of even greater significance.

Where he can lose is in not getting the *next* contract. The defense contractor's backlog may look beautiful today, but if he is not building advanced skills and technologies, if he is not studying the customer's future needs, then he is certainly headed for trouble at some point in the future.

Let me give you an example. In 1952, Martin made the major decision to phase out of the basic business in which it had pioneered for thirty years: building airplanes. We decided to devote ourselves to guided missiles and their accompanying ground support equipment.

Increased Missile Expenditures

In the year before we made this decision, 1951, the Government had spent only \$21 million on missiles, and \$2.4 billion on aircraft. In our year of decision, 1952, the Government increased missile expenditures eight-fold

(Continued on page 65)

Engineer inspects Styroflex® cable installed on an antenna array at one of Pacific Scatter Communication System stations shown at right.

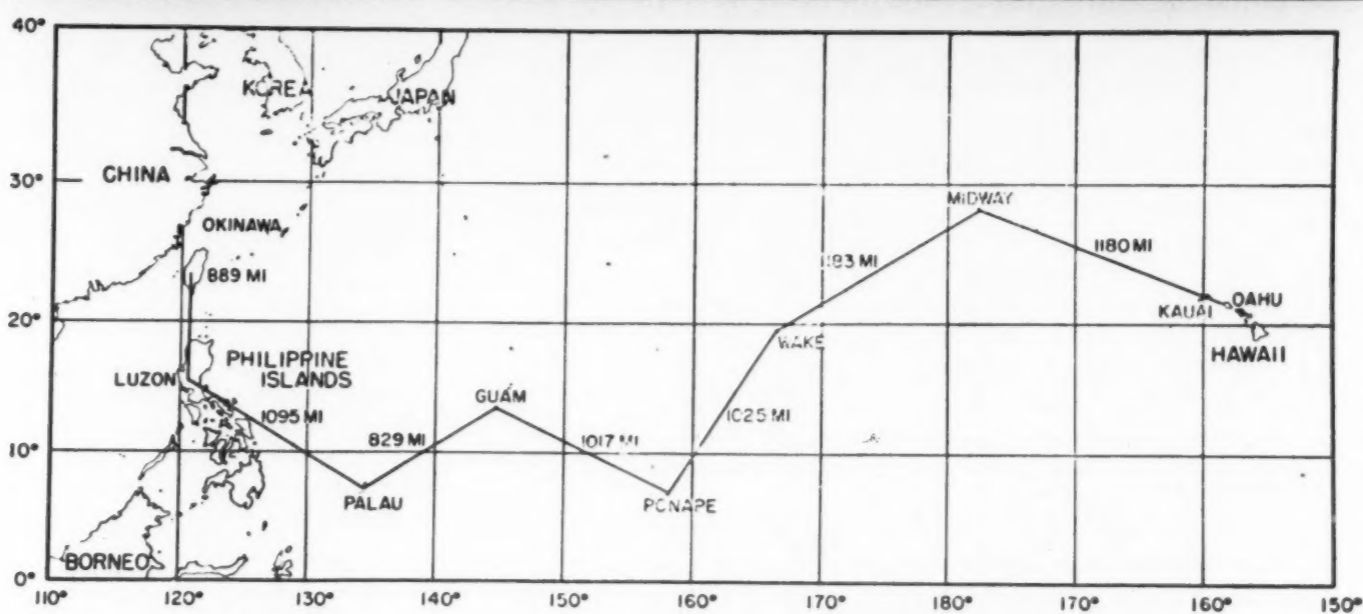
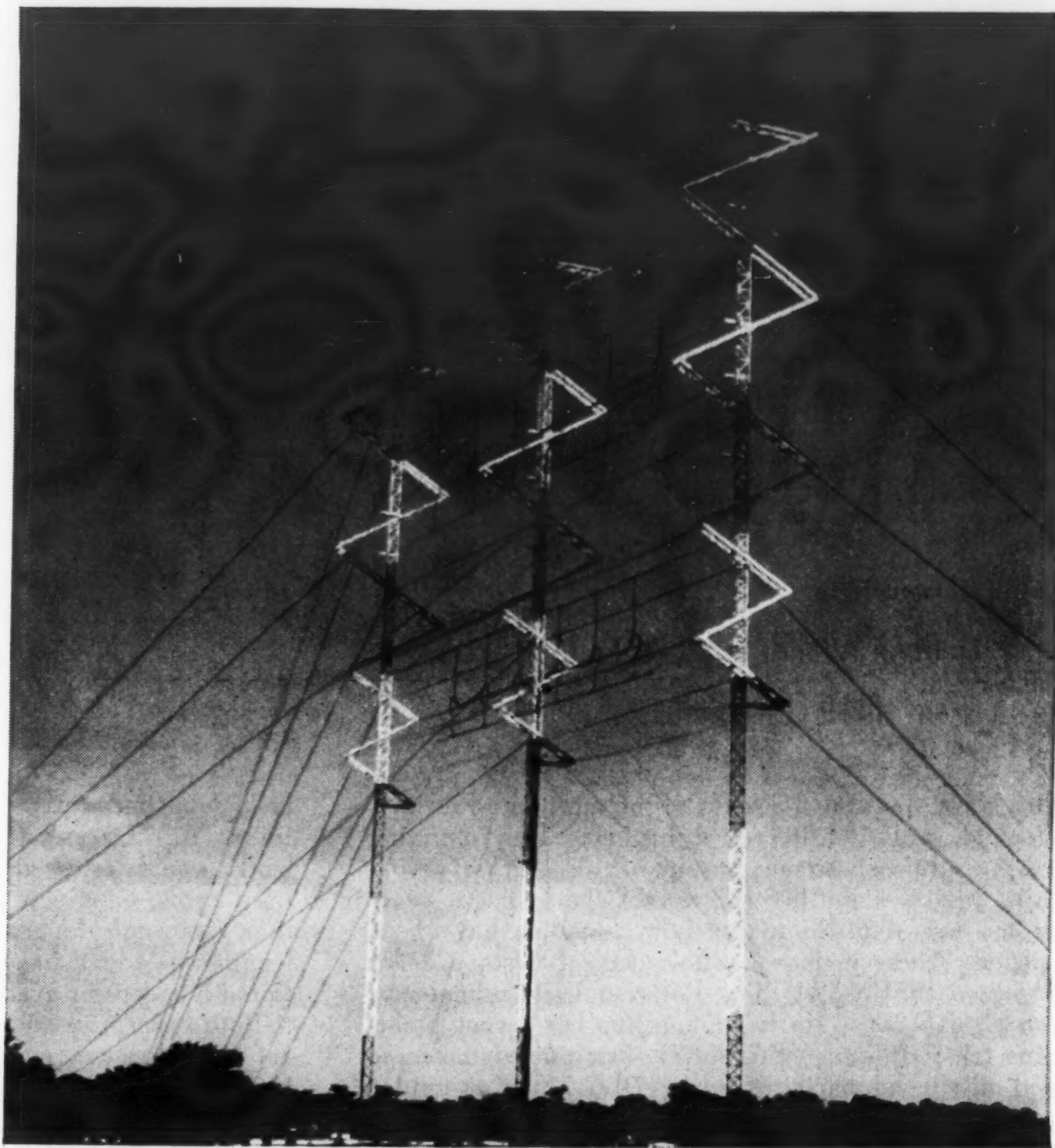


Over 40 miles of *Styroflex*® Coaxial Cable help assure

More than 200,000 feet of Styroflex® coaxial cables are in active use as balanced antenna feed lines in the recently completed Pacific Scatter Communication System stretching from the Hawaiian Islands to Okinawa. This trans-Pacific system, one of the largest and most advanced of its kind in the world, uses ionospheric and tropospheric propagation techniques that produce over 99% reliability. An important part of the Strategic Army Communications Network (STARCOM), the system was designed, developed and constructed by Page Communications Engineers, Inc. for the U. S. Army Signal Corps.

Each of the nine stations in the network is equipped with the same major component parts—transmitter exciters, multiplex terminals and antennas. The cables used in the 200- and 400-foot antenna arrays range from 7/8" jacketed Styroflex® cable to 3 1/8" jacketed Styroflex® cable. About 7,000 feet of 1/2" jacketed Foamflex® cable is also used in the system. The Styroflex® cables were spliced in the field by an inert-gas Heliarc welding process to assure noise-free connections required for successful duplexed antenna operation.

The extremely low inherent noise level and low attenuation of Styroflex®—together with this ai



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(Photos courtesy of Page Communications Engineers, Inc.)

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The Challenge Facing The Navy-Industrial Team

by REAR ADMIRAL RALPH K. JAMES, USN
Chief of the Bureau of Ships

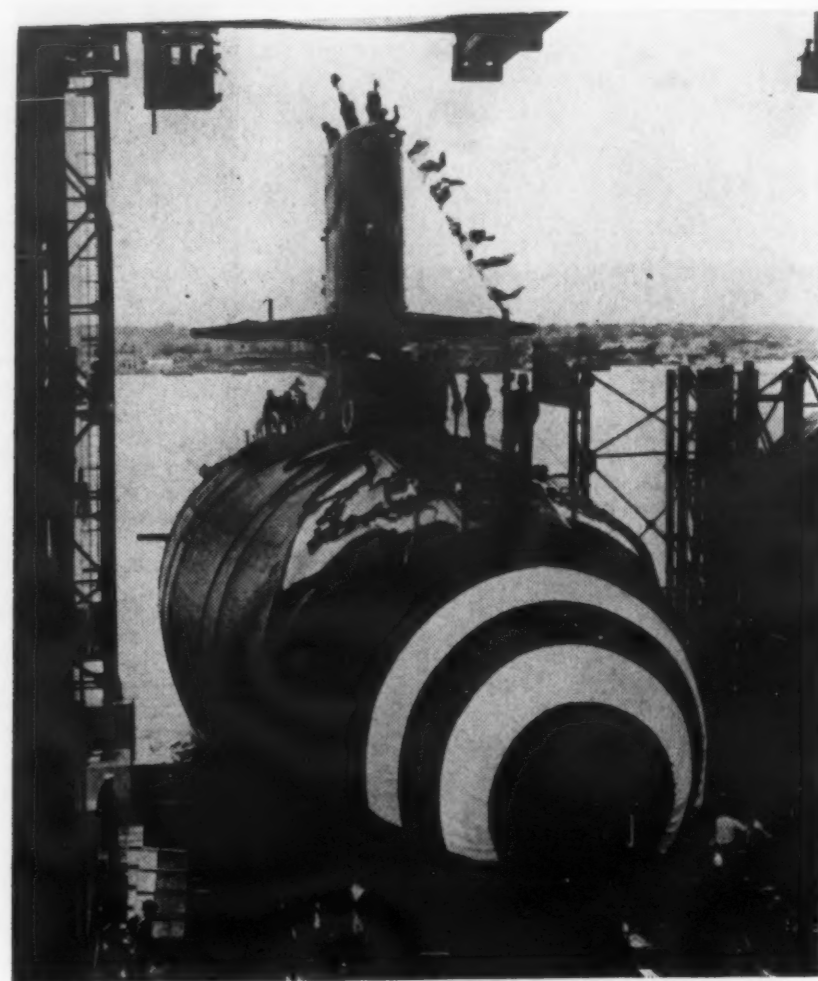
OUR NAVY HAS HAD 15 years of the most rapid technological evolution in world history. The operating forces now are seeing many results of this 15 year period in ships just now putting to sea. In the last two years alone, no less than 25 major new warships have been completed. These include a whole fleet of firsts: *George Washington* (SSBN-598), first Polaris missile submarine; *Triton* (SSRN-586), justly famous for her recent globe-circling trip; *Halibut* (SSGN-587), first nuclear powered guided missile submarine; *Dewey* (DLG-14), first guided missile frigate completed; *Charles F. Adams* (DDG-2), first new construction guided missile destroyer out to sea; *Skipjack* (SSN-858), first submarine embodying both nuclear power and the *Albacore* hull form. The Navy's first guided missile light cruisers—6 of them, all conversions—also were finished during these two years.

At least 25 new ships will be completed during calendar 1961 alone, including both *Kitty Hawk* (CVA-63) and the now delayed *Constellation* (CVA-64), the nuclear powered guided missile cruiser *Long Beach* (CGN-9) and some 24 guided missile destroyers and frigates, Polaris missile submarines, and nuclear powered attack submarines. (Editor's note: Aircraft carrier *Kitty Hawk* was commissioned April 29.)

We are thus bringing 15 years of technological development to the Fleet in a major way. Meanwhile, development continues unabated. You can best see what is going on by looking at some of the ships in current construction and conversion programs.

Carriers, of course, continue to be the keystone for Navy operations. *Enterprise* (CVAN-65) and CVA-66 recently placed out on contract, continue carrier evolution. The earlier landmarks of that evolution are: *Langley* (CV-1), *Essex* (CVA-9), *Midway* (CVA-41), and *Forrestal* (CVA-59). The evolution has, of course, been dictated largely by the steeply rising weight and landing speed of aircraft, which in turn determine the length of catapults, how high the capacity of the arresting gear must be and how long its runout, the length of the landing area, and so on.

Our heaviest carrier-based aircraft require a runout of approximately 320 feet in order to stop with reasonable deceleration loads; this factor alone helps to explain why our carriers must be so very large. It should be noted that *Forrestal's* designers were farsighted. They



looked beyond current aircraft requirements and to the future. As a result, CVA-66 is designed to handle the heaviest and fastest aircraft existing now or on the drawing boards, on a new hull of virtually no greater length than *Forrestal*. *Enterprise* is significantly longer but this length was added in order to utilize more fully the additional horsepower available from the nuclear power plant.

Both *Enterprise* and CVA-66 will have the Naval Tactical Data System, commonly known as NTDS. As you know, weapons have become so fast and tactical problems so complicated that human responses simply cannot operate with sufficient speed to be effective. The NTDS has been developed in response to this problem. It achieves a high degree of automation in data collection, processing, exchanging, and evaluation by using computers and digital data processing techniques. NTDS is a new tool of command which will provide a clear, concise picture of the tactical situation and alternative courses of action that may be taken in time to meet a threat effectively.

Let us now turn to our new battleship, the Polaris submarine. As you know, *George Washington* and *Patrick Henry* already have been deployed. The whole mobile Polaris system is now operational. We now have a worldwide missile capability which is practically invulnerable.

Three of these ships have been completed. Four more will be commissioned in calendar year 1961. We are tremendously proud of this progress. The Polaris submarine building program did not even start until late in fiscal year 1958 when we requested funds in a supplemental appropriation. We took attack submarines already on the ways, redesigned them to include 124-foot missile compartments, thus developing the first Polaris submarines.

We are incorporating improvements in the ships as rapidly as possible. They have come fast enough so that only the first five ships are of the *George Washington* (SSBN-598) class. Five more are of the *Ethan Allan* (SSBN-608) class, which is longer and has considerably greater test depth. Four of the 1961 program ships are of a still newer class, the *Lafayette* (SSBN-616) class, which differs primarily in being longer in order to provide for recreation, study and exercise areas, which will enhance the efficiency of the crew confined to a restricted space over a long period of time. Incidentally, these ships are really big—the *Lafayette* class will have a submerged

(Left) Military and industry

personnel launch the Skipjack, the first

submarine embodying both

nuclear power and the Albacore

hull form.

displacement of over 8000 tons. (Editor's note: President Kennedy's revised military budget calls for construction work to begin on five additional Polaris submarines this year, and ten additional subs for 1962.)

Polaris missile submarine developments draw heavily, of course, upon our experience in building nuclear powered attack submarines. At present we have standardized to some degree on the *Thresher* (SSN-593) class. They are capable of diving to greater depths than previous classes and are the quietest submarines ever built.

Although we have already increased test depths on our submarines very considerably, experimental development with the deep diving submarine in the 1961 program is expected to enable us to take a major additional step. We expect to learn a great deal about hull structure and sonar and weapon performance at greatly increased depths. The design emphasizes small size, active and passive sonar, and instrumentation for acoustics and oceanographic research, as well as increased test depth.

With advances of this type, we are running into the need for better and simpler control of submarines. We have just made a major stride toward achieving such controls with what we call the Contact Analog. This is a television-like display intended to give a single "driver" of a submarine the impression that he is looking through a window in the prow of the ship and can see the ocean surface above, the floor below, and possibly mines or other submarines in the water ahead. He will see what looks like a highway suspended in the water before him. His job is to stay on that highway. Orders from the captain to ascend, dive, or change course will change the highway's position on the "windows." The driver adjusts the submarine to stay on it. A model of this Contact Analog is at sea for extensive evaluation.

In surface ships, we see missiles a dominant factor. The Navy has built or has in its programs 25 guided missile frigates, the nuclear powered guided missile cruiser *Long Beach* (CGN-9), and many guided missile ship conversions. (Editor's note: President Kennedy's revised military budget cancels plans to install Polaris missiles on the *Long Beach*.) In all major types you can see rapid progress. Experience gained with early ships is ground into later designs as soon as possible. The DLG-26 class in the 1961 program, for instance, will be considerably longer than the *Leahy* (DLG-16) class ships, primarily in order to accommodate drone anti-submarine helicopter facilities and installation of long

range bow mounted sonar.

The impact of electronics on these missile ships is tremendous. The guided missile cruisers, for example, will have 16 major antennas and in addition will use a part of the superstructure as a radiating antenna for communications. The problem of smoke damage to radar antennas and of supporting them is a tough one. Our answer is to combine masts and stacks into unified structures known as stack-masts. Smoke is discharged at high velocity from pipes extending horizontally from the stack-masts near their top.

A word on amphibious types. There is rapid progress in this field as well. Two new ship types especially designed for implementation of the Marine Corps vertical envelopment concept illustrate this. One is the amphibious transport dock (LPD), which is capable of carrying a balanced load of marines and all of their equipment along with helicopters and boats needed for landing operations. There is a helicopter platform aft. Under it is a well which can admit the sea, permitting landing craft to motor out under their own power. Both landing craft and helicopters may be launched either while the ship is moving or when it is stopped. The ship serves the function of tank landing ship (LST), attack transport (APA), attack cargo ship (AKA), and docking landing ship (LSD) types of World War II vintage. The other type designed for the vertical envelopment concept is the amphibious assault ship (LPH). The LPH can transport some 2000 Marines with all their supplies and equipment and 20 to 30 helicopters to land them. (Editor's note: An additional amphibious transport "of a new type, increasing both the speed and the capability of Marine Corps sealift capacity" will be constructed with \$40 million included in the revised military budget.)

Anti-submarine warfare is, of course, one of our key problems. One answer to the problem is the DE-1040 class, in the 1961 program and the guided missile escort ships in the 1962 program. These escort vessels are especially designed for optimum performance in locating and destroying enemy submarines. These ships will have drone anti-submarine helicopter (DASH) facilities, ASROC, and other advanced ASW weapons, along with integral bow-mounted sonar. They will be longer than previous class ships in order to take maximum advantage of the increased power available from pressure-fired boilers to be installed. In addition, the 1962 program ships will have Tartar missiles.

The pressure fire boiler delivers greatly increased power but also achieves about a 50 per cent reduction in space and weight. It affords greater ruggedness and shock resistance, decreased maintenance and simplified operation. It eliminates brickwork, fire side corrosion, fuel oil heaters, forced draft blowers, and much reduces light-off time.

Even the auxiliary fleet must make great strides in order to keep up with the new Navy. We are building in the 1961 and 1962 program two each of two new types of replenishment ships that are tremendous strides forward. They incorporate the latest in cargo handling features and combine functions previously performed by two or more ship types, thus permitting replacement at a better than one-to-one ratio. These ships will teach us lessons we can use to help solve problems of block obsolescence in the auxiliary fleet.

Largest of the two is the fast combat support ship (AOE). It is a tremendous ship for an auxiliary, bigger than the battleship *North Carolina*. Her powerful machinery plant will enable her to steam with a striking

(Continued on page 68, col. 2)



RCA AIRBORNE SINGLE SIDEBAND

Performance proven in Operation "Deep Freeze"

RCA's single sideband modification of the 618S-1 high frequency communication equipment has demonstrated proven capability under actual flight operations during Operation "DEEP FREEZE," now being conducted by the U. S. Navy with the support of the U. S. Air Force and MATS.

The RCA concept of modifying proven, existing equipments, such as the AN/ARC-65, has resulted in the most economical approach to the utilization of single sideband performance capabilities. The 618S-1/MC and AN/ARC-38A SSB modifications are the latest additions to the family of RCA Communications Equipments now providing extra capability to meet present and future military and civil operational communications requirements.

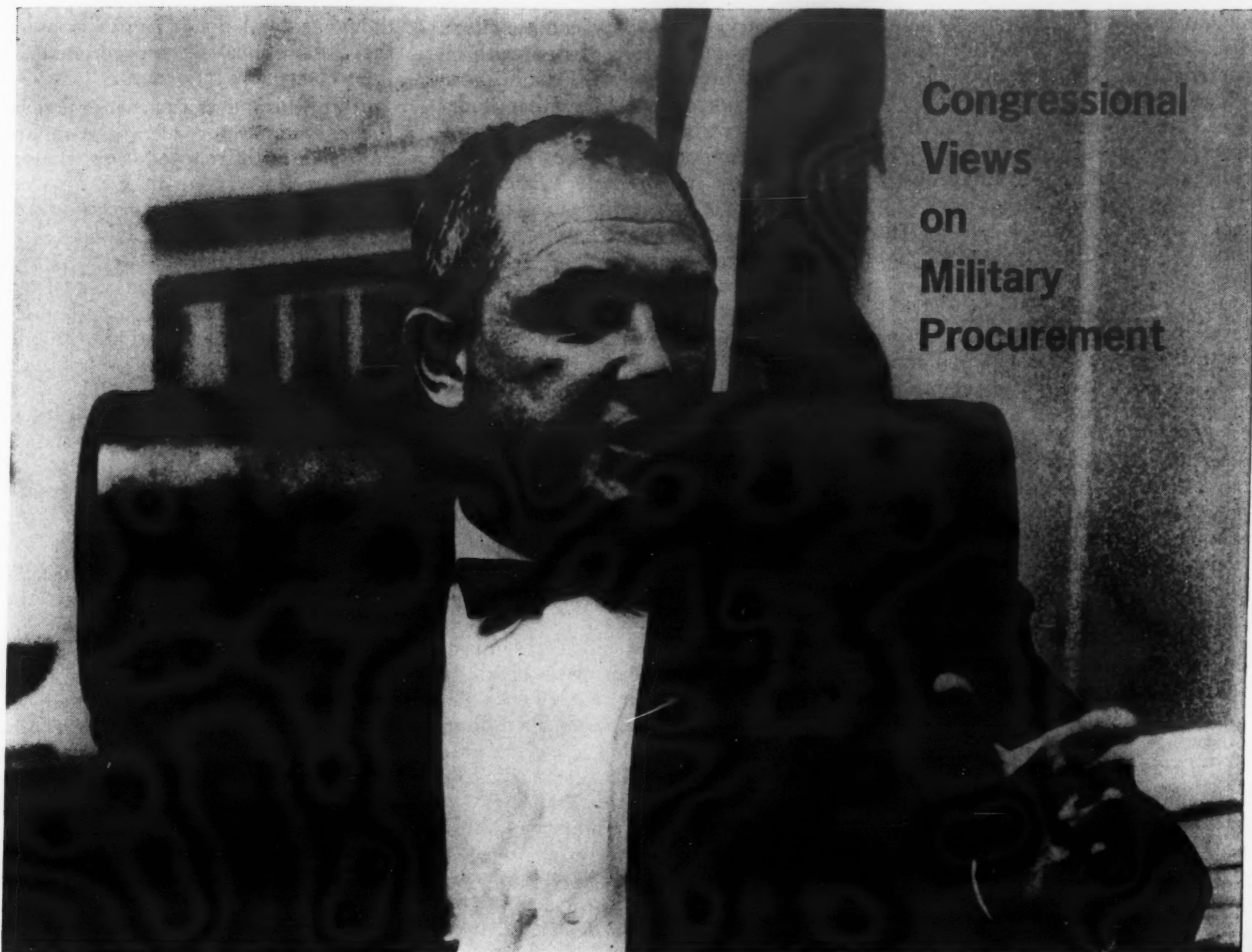
Several thousand RCA Airborne Single Sideband Equipments are now in flight operation.



For further information on the 618S-1/MC, AN/ARC-38A, and other airborne communication equipments write: Marketing Dept., Airborne Systems Division, Defense Electronic Products, Radio Corporation of America, Camden 2, New Jersey.



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Congressional Views on Military Procurement

THE PURPOSE OF MILITARY defense is to protect our society, our way of life. It is entirely conceivable that in the very process of setting up a defense which is adequate we can alter to the point where we can call it destruction to the very way of life we seek to protect. Many societies in history have done just that. Certainly we have been conscious of this danger on several occasions in the past when we have had to go to war. Going to war meant a society operating under martial law to a large degree, not a society operating under civilian law. Today we are in a period of what some have termed cold war which means, if nothing else, that we do not move dramatically from one type of social organization to another as we do in hot war, and therefore we are not so conscious of what might be basic changes that may be going on in our social structure.

Another way to put it is this. Modern military preparedness depends upon a strong economic structure. Anything that undermines the sound-

ness of the economic structure in the long run weakens the military strength.

It is because modern military preparedness requires such a great portion of our economic effort and depends upon our continued economic advancement that I encouraged the Joint House-Senate Economic Committee last year to set up a subcommittee on defense procurement to study and follow what was going on and what might transpire in this area. I am glad that this subcommittee, which has already issued its first report and staff prepared background material on Economic Aspects of Military Procurement and Supply, has been made a regular subcommittee.

I believe I must discuss my subject from the standpoint of how men are best organized to do a continuing job with a basic realization that I am talking about men, not angels or paragons.

It is very difficult to talk about

procedures in the field of human endeavor because one always must illustrate the point with human beings. Just as soon as you use human beings to illustrate a point you lose the concentration on the point because people seem to be more interested in personalities than ideas.

This is particularly true in a society like ours where we try to make government of, by and for the people work. Over the years when I, in the Congress, have been trying to understand and improve our system of military procurement and at the same time preserve the strength and vitality of the economy which makes it possible, and individuals in the military branch of government have been trying to do the same thing, a great area of understandable misunderstanding has grown up between us. The misunderstanding is understandable because our points have almost always been made in terms of human examples.

The Press takes what is frequently meant only as an illustration of a

by **THE HONORABLE THOMAS B. CURTIS**
United States Representative, Second District, Missouri

procedure, personifies it and we immediately have a matter of honest discussion bogging down in a case of personalities. Then too in the field in which I work, the field of liaison between the military and the home front, my constituency, many of my colleagues find it advantageous to prolonging their political careers to make mischief out of problems instead of trying to understand and solve them.

It is understandable why the military, who frequently bears the brunt of this mischief, becomes calloused. I would only say that all of my colleagues and myself, whatever our offenses to the military or to others may be, are the ones who have to have the most calloused hides. Military people may receive less attention and therefore less appreciation than do we at times, but I know our hides are tougher and more scarred. Being in public life in a modern democracy ruled as it is to a large degree by an un-self-disciplined fourth estate requires it. Even so the barbs can sometimes sink through our toughness into our tender flesh and divert us from our mission.

"Military procurement has had a major impact upon the national economy and segments thereof during the past two decades. Procurement of supplies, materials, and weapons amount to \$22 to \$25 billion per year. From fiscal year 1950 to 1959, inclusive, there have been 38 million procurement transactions with a dollar volume of approximately \$228.4 billion.

"Military transportation bills amount to several hundred million dollars annually.

"The inventories of supplies in the many duplicating military supply systems amount to some \$44.4 billion and are stored in 585 million square feet of depot space throughout the world.

"The annual cost of maintaining the many military supply systems is conservatively estimated at \$2 billion.

"The annual disposal of surpluses according to congressional testimony runs from \$8 to \$10 billion, with a net return on sales of less than 2 percent of cost. Many of the sales have a serious impact upon portions of the economy."*

Formula for Government Revenue

In spite of these considerable fig-

*Report of Subcommittee on Defense Procurement to the Joint Economic Committee, pages VII-VIII.

ures, I am satisfied that if it becomes necessary, our society can spend an even greater portion of its wealth on military preparedness. I doubt, however, if we can do this either under the present military procurement system or under our present economic structures, particularly under our present tax laws without damaging either the long run defense posture or the nature of the society we are seeking to protect. I will not dwell on the tax aspects of the problem other than to cite the basic formula for government revenue, which we so blithely ignore. Tax take equals tax rate times tax base times the factor of collectibility. The factor of collectibility diminishes markedly as tax rates go up and increases as tax rates go down. A broad tax base with a relatively low rate therefore brings in more revenue than a narrow base with a higher rate. If we do not revise our basic approach to taxation by lowering rates and so remove the impediments to economic growth which have been placed in our tax laws we cannot increase our revenues for military expenditures without creating great damage. Yet by broadening our tax base we can do this. This is one reason why the military establishment should endeavor to have as much of their needs as possible procured from the private sector of the economy and not provided by itself.

An area where our tax laws meet military procurement illustrates both the points of the law of diminishing returns in taxation to which I have been referring and to a method of military procurement which is inefficient and does not permit the best utilization of professional manpower.

I am talking about the Renegotiations Act passed in the war days of emergency procurement when technological advancement was at a much slower pace than it is today.

The Renegotiations Act is a tax law which permits the federal government to call in a contractor after the completion of a contract and through bureaucratic action determine the amount of profits he shall be permitted to retain on the contract. Those who argue for the Renegotiations Act continuance state that it is necessary because neither the government nor the contractor know what the cost of making a new and complicated military weapon, for example, will be. The contract under these circumstances, it is argued with merit, has to be negotiated rather than be let by advertised bid. Even after negotiation, it is argued no one knows what

the cost will be. Accordingly, even though a total dollar figure is used, that figure must be renegotiated in light of actual experience.

All of this makes such sense that in the private sector of the economy contracts with renegotiation clauses in them are written all the time on experimental machines or equipment, or for research and development. The point isn't whether the contracting parties agree in their initial contract to renegotiate, the question is who should do the renegotiation? Should it be the personnel who worked out the original contract and followed it through to its completion—the personnel of both the parties? Or should it be personnel that has had nothing to do with the contract, and indeed has no technical knowledge of the subject?

I have suggested that an intelligent procedure would be to have the knowledgeable personnel do the renegotiating. The only argument advanced by those who have favored a Renegotiation Board composed of people who know nothing about the technical problems in the contract entering the picture is lack of trust in the integrity, or perhaps the knowledge and ability of the original personnel. Who in our society deals with new things? The answer is our best people—best in technical abilities and I would suggest best in moral outlook as well. The argument has been advanced that the military procurement officers are at a disadvantage in light of the superior knowledge of those in industry with whom they deal. I do not believe this. If this were so, I suggest that the answer then is, get the calibre personnel necessary to put this negotiation on an even basis. There is only one way I know to get the personnel you want and that is to be willing to compete for it on the labor market, or undertake the cost of training it and retaining it yourself.

In the process of a Renegotiation Board's dealing with matters beyond its comprehension, we have successfully prevented an industry independent of government financing from growing up in many of the areas where the military must procure new weapons. We have effectively shut off new private investment from moving into these areas; we have not even permitted that which is a second best way of financing, retained earnings, to do the job necessary to be done.

In our recent hearings of the Ways and Means Committee on the subject

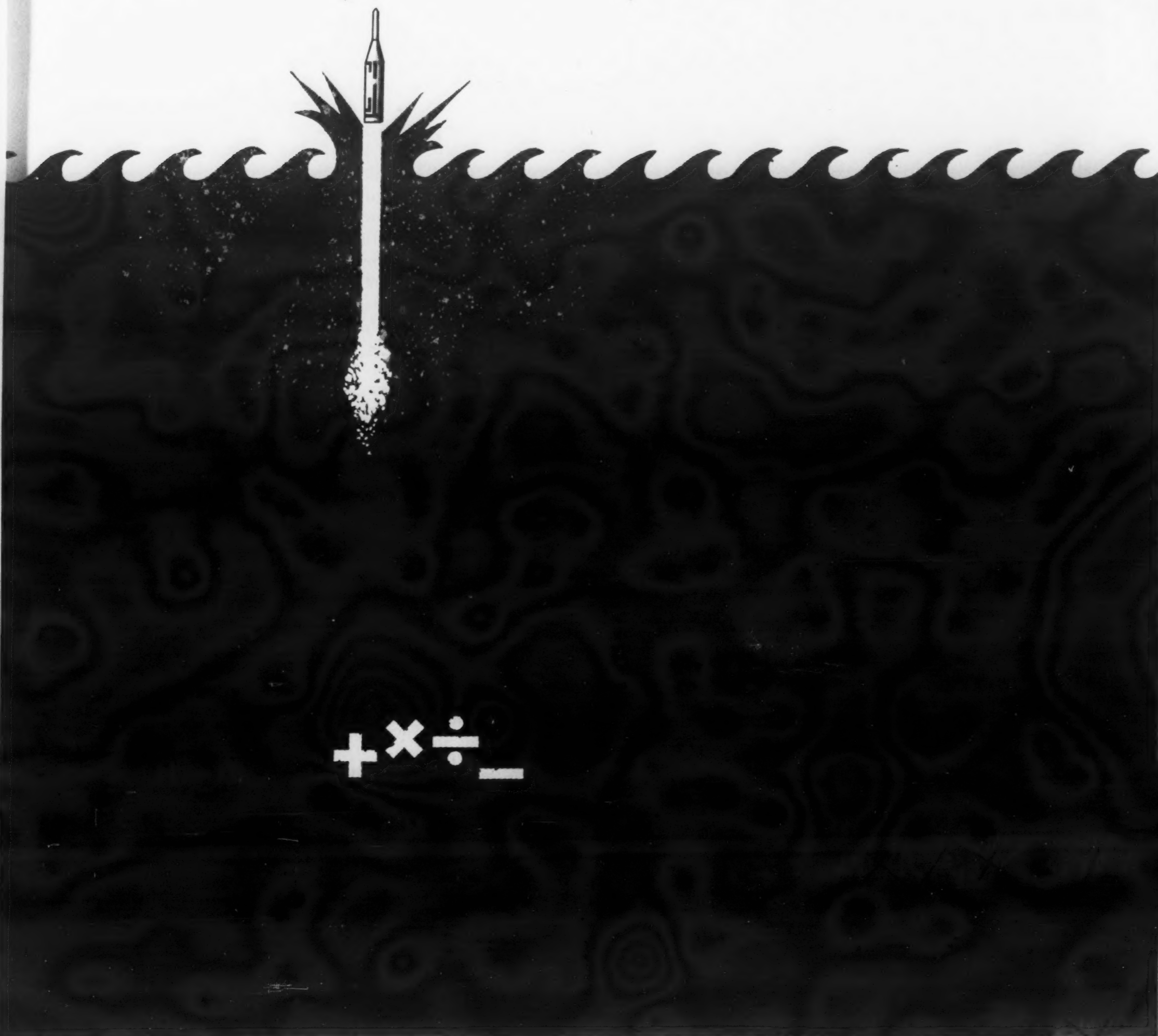
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*COMP'UTENCE

at work in Polaris program

The mission: to develop and manufacture the electronic digital computer that provides stabilization for the submarine periscope or radio-metric sextant; resolves celestial information in bearing and elevation order signals; provides data for the correction of the inertial navigator; and compensates for the effects of roll, pitch, heading, and mast flexure.

The means: Burroughs Comp'utence. **The results:** precise launchings for Polaris. **Other USN missions-accomplished:** Polaris Fire Control Switchboards, aircraft carrier landing systems (through Burroughs Control Instrument Co.), and advanced digital airborne computers. **The message:** Be it by land, sea, air or space, Burroughs Comp'utence—ranging from basic research through production to field service—takes its bearings, goes straight for the goal. Burroughs--TM

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*COMP'UTENCE / *total competence in computation*

of the extension of the Renegotiations Act, the advocates of extension stated, "We will not give the airframe industries a full return on their claimed investment because government has provided much of the financing. Private capital will not invest in the airframe industries because the risk is too great, therefore government must provide the financing." I would suggest that some thought be given to what is a proper return on risk capital. The return should be whatever is necessary to attract the capital. This is a properly controlled economic factor so long as the investment market is free. We make no economic saving by providing government risk capital in lieu of private risk capital—this does not alter the risk, it merely hides the cost and removes the process from the tax base. It also removes the process from the intricate check and balance system of the free market place.

The result of this procedure is that the airframe missile industries today, after 20 years of rather sizeable growth, are in a position less able to finance military contracts than before they started and very few new private capital ventures are willing to enter the field. Indeed, it is also to be noted that some of our best private concerns will not contract with the government because of what they feel to be the unfairness of the contracting procedures. There is little question of what happens under a continuation of this kind of process. The firms who get contracts do so under methods that are unrelated to quality of performance. The one doing the procuring, the government, pays through the nose, because none of the benefits of the free market system are gained.

I want to explain the rationale behind another congressional policy, one with which I agree this time, but which on its face might seem costly. This is the policy which seemingly gives preference in government contracting to small businesses, whatever a small business may be defined to be. I have always defined a small business to be one which could not afford to send its representative to Washington. I want to make it clear that by saying I favor the policy which on its face seems to favor small business, I am not approving much of what is in our present legislation which has been written under the guise of carrying out this principle.

I was on the House Small Business Committee in the 82nd Congress and I still retain a very basic interest in its welfare—here is the area from which springs much of our new eco-

nomie growth—here is the origin of many of the new economic ideas. Manufacturing is only one segment of the economic process. Distribution and service are equal segments and in a sophisticated economy actually loom larger than manufacturing. We are seeing this fact in our economy today where employment in production is declining while production and the capabilities to produce are increasing; and employment in distribution and service areas is increasing.

I have spoken before many small business groups and like to begin my remarks by urging them never to let anyone take away from them their basic and most important right—the right to fail. Where indeed is the hope of the small businessman who is capable and efficient to succeed and fulfill the good American dream of becoming big, if a floor is put under his inefficient competitors?

I want no favoritism for small business in military contracts or otherwise. However, in the very nature of the procurement business conducted on the vast scale that the military establishment must conduct it, there is a natural and built in bias which favors the big contractor over the little contractor which has nothing to do with the respective merits of the two to perform the contract. This bias comes from part of the process of being in business—seeking customers. The smaller the business, and in many respects, the better the quality of its work, because of its concentration on this aspect of staying in business, the more it relies on reputation to pass its name around and the less on its own sales organization. Big corporations have found that it pays them to make a search effort for contractors and not just rely upon the sales effort of the outfit trying to sell to them. So government procurement officers must seek out contractors. The area of search must be the smaller firms with no sales organization and with no Washington representative.

A second reason stems from the fact that if a contract turns sour a procurement officer who has dealt with a large or name company at least doesn't have to explain to his superiors why he dealt with that particular company. If, on the other hand, the company were small and unknown that might become, and indeed could legitimately become one of the sources of criticism that a review of the contract brings out. I would observe, however, that a higher percentage of error resulting from this procedure of dealing with smaller

firms up to a point is more than compensated by more lower cost and better quality contracts. The government, after all, pays for the cost of the sales efforts of those with whom it contracts.

Finally, the federal government primarily through the military sector has entered the procurement market to such an extent that its procurement practices can and probably do alter the normal operation of the free market process. The mere size of military procurement brings this about. Therefore, procurement practices on the part of the federal procurement personnel that conform to good economic practice are important. It is important to keep the relationship, whatever that may be, of big business to small business. What relationship the free market would decide as necessary to sustain a vigorous and healthy private economy is, of course, somewhat of a guess. However, the seed corn must be allowed to sprout if it is good seed. Conversely, the growth already established must be kept healthy by the competition that the new growth renders.

The Work of Congress

I find that many people misconstrue the work of the Congress through a misunderstanding of how the Congress operates. Many Congressmen can be included in this group. The House of Representatives operates through committees. In the process of setting ourselves up by committees we split many whole subjects into strange component parts.

In the foregoing discussion you may have perceived some of this. I have referred to four committees, none of which, by definition, deal with the military establishment. Yet in vital ways all four of them have a great impact upon military procurement. It is perfectly true that when the Ways and Means Committee undertakes to alter the Renegotiations Act, Chairman Vinson of the Armed Services Committee is over testifying and doing a bit of lobbying here and lobbying there to get his views across. It is also true that when the Bonner Subcommittee was operating the Armed Services Committee kept close tabs on what it was doing. So did the Subcommittee on Military Appropriations under George Mahon. There is some liaison between House Committees but nowhere near the amount there should be. The result is that some important phases of military procurement never receive the atten-

(Continued on page 77)

I HAVE CHOSEN as the subject for this article the ever-increasing cost of equipping our combat forces. This subject is currently of paramount interest and concern to me and to the Army staff at the highest levels. It is a subject of special interest to a contractor, or anyone having expectations of doing some contract work for the Army.

This is not to say that we have not always been concerned about costs. We have. We have always endeavored to get the most out of every dollar appropriated for our use in providing a maximum combat capability for our Army. We have endeavored to keep our Army modern, and in the required state of constant combat readiness. We have endeavored to provide our combat forces with the best and most effective equipment of any forces in the world. For we are ever conscious of the fact that superior equipment offers distinct advantages to our fighting men on a battlefield where they may be greatly outnumbered. In such a situation, superior equipment, in fact, is our only alternative.

But we have also been mindful of the fact that cost is a compelling consideration for several reasons. Apart from the fact that waste or inefficiency—in any form—is morally unacceptable to us, any dissipation of funds appropriated for our use means a corresponding dilution in the effectiveness of our troop support. The consequences of failure to support our troops effectively, in any situation, are so grave in their implication as to be unthinkable. Consequently, we desire at all times to conserve those resources we have in order that we will have sufficient to meet the need when the “chips are down.”

There is also the question of what our national economy will stand. A Defense budget that has consistently run into billions of dollars for the past several years represents a real drain on our national resources. The nature of the threat to our national security is such that we must not only maintain a posture of military strength but one of economic strength as well. Anything that we in the military can do to lessen the economic burden upon the national resources—and upon the taxpayer—strengthens the national economy accordingly. We want *enough* money to perform our mission effectively, but no more than *enough*. So, despite any accusations you may have heard about waste in our operations, *cost* is of paramount concern to us—and *price* is an object.

Because of the nature of our business, where we must be prepared for any eventuality—of some uncertain nature—at some uncertain time—and in some uncertain place—there are bound to be some miscalculations and errors in judgment which result in mistakes. I am sure industrial organizations have it in their businesses where pertinent factors are eminently more predictable. And so we have it in ours where future requirements are considerably more obscure. The ever-increasing cost of equipping our combat forces has assumed such critical proportions in recent months as to cause more than usual concern. Consequently, we have had to conduct a thorough re-examination and re-evaluation of our entire program for new possibilities in cost reduction.

The increasing cost of equipment can be attributed largely to a number of important factors.

Demand Factor

One factor is the increased quantities of equipment authorized. Operational concepts in modern warfare require wider dispersion and greater mobility of our forces. This means more and better communications and an improved capability in combat surveillance, target acquisition, air traffic regulation and control, and automatic data processing.



is an object

by MAJOR GENERAL R. T. NELSON
Chief Signal Officer, USA

PART I

A current Infantry Division, for example, is authorized 40 percent more items of communications-electronics equipment than an Infantry Division in 1950. Because of the wider dispersion and greater mobility of forces considered necessary, authorization for Infantry Division radios of all types, for instance, was increased from 1751 to 2457. So great has been this increase in the number of radios, there is some thought that we should redesignate our active combat forces as our “Radio-Active Combat Forces.”

As another instance, authorization for radars was increased from 3 to 50, the majority of these being used to provide a capability in combat surveillance.

Performance Factor

Another factor is the higher quality of performance demanded of the new equipments needed. With greater reliance being placed on communications and surveillance for command and control of a modern, mobile Army, new techniques and new equipments have had to be developed and these must meet severe operational requirements. There are requirements for increased reliability, greater versatility and flexibility, greater channel capacity, greater range, a reduction in size and weight, operational capability under a wide variety of environmental conditions, and protection against interference. Maintainability and standardization of parts, along with transportability, are also features demanded by the logisticians. The design and production of military equipment with military characteristics that satisfy these requirements is not achieved without cost.

New Technology Factor

As to new technology—as these communications-electronics requirements for the Army have become more and more complex, we have had to push the state-of-the-art more than ever before in order to come up with the type of equipment needed. In situations where we have optimum requirements, and where we are going beyond

the known in the state-of-the-art, development costs come high—and the more advanced or original the development, the higher the cost will be.

Contract Problem Factor

The next cost factor is *contractual difficulties*. From the cost control and budgeting side, this involves selecting that type of development contract which will assure the best working arrangement for all concerned—and making it sufficiently definitive as to scope and specifications so that performance costs can be more accurately estimated.

Development work, as you know, is done principally under negotiated contracts which fall into two classes—(1) cost-plus-fixed-fee, and (2) fixed price. Because it is often difficult or impracticable to write sufficiently definitive specifications for a fixed price development contract, the cost-plus-fixed-fee contract is more often used for research and development work. The cost-plus-fixed-fee contract has come into even wider usage in recent years because greater emphasis has been placed on the development of *systems* rather than separate *items* of equipment.

The difficulty of accurately estimating performance costs on an R & D contract in advance, and the steady increase of development costs in the rising spiral of our economy, have given us a "king-sized headache" with respect to our cost-plus-fixed-fee contracts. Additional funding has frequently been necessary to meet the increase in costs over that provided in our budget estimate. Any unexpected increase in the cost of a contract is often called an "overrun." This is to use the term in its most general sense.

The requirement for additional funding has been particularly severe in the last two or three years in the larger development programs where large amounts of money are involved. The effect has been almost disastrous in respect to the number of new developments that could be initiated, and in some cases has seriously jeopardized existing development programs, test schedules and production for issue to troops.

Time Factor

The last factor having an important bearing on increased costs is the criticality of the time element. Wherever we have a sufficiently long period of time for development, maximum cost-reduction can be accomplished with comparative ease through detailed cost reduction studies. But the demands often are for some urgent new requirement where development time must be considerably compressed. Our rapidly-advancing or rapidly-changing technology constantly generates urgent new requirements. The criticality of this time element is an important factor in determining costs.

Now you may well ask what can be done to alleviate this distressing situation of ever-increasing costs. What are we in the Army doing about it, and what do we propose? What can the members of that Army-Industry team upon which our nation places such great dependence, do to help us?

In any approach to this problem, there is general agreement that we must strive for a more proper balance between complexity, cost, and effectiveness of communications-electronics equipment. Any requirements contributing to greater complexity of equipment must be thoroughly reevaluated in terms of their effects upon our operational objectives. Any requirements as to increased quantities must be carefully reviewed to determine to what extent the increased quantities are necessary. We must also bear in mind the possibility that we will be faced

with a form of *electronic paralysis* if the number of communications-electronic devices in the combat zone is not rigidly controlled.

Above all, these considerations must be weighed against the considerations of cost. What is truly essential? What is the cost? What can we afford? Are we willing to pay the price?

As to the quantity and quality of equipments, the final determination must be made by the user. And only the user can judge whether the cost involved is justifiable. Decisions in these matters, however, must be consistently reviewed by all concerned.

In this connection, last year, in coordination with the Continental Army Command, I established a working group within my office to examine existing tables of Organization and Equipment, qualitative material requirements, military characteristics and engineering test specifications to determine whether any of the requirements or standards could be relaxed or reduced without adversely affecting operational reliability.

An example of immediate results obtained concerns equipments intended solely for mounting in shelters, such as vans or trailers. It was agreed that these *need not* be designed and packaged to the same stringent specifications as those equipments for use without shelter protection. Therefore, sizeable cost reduction will be achieved in this specific case.

We are taking a look at similar modifications and adjustments and we feel these are possible for other areas of communications-electronics equipments, particularly when the ultimate use of the equipment does not justify the complexity and expense involved in meeting a common set of stringent military design characteristics. We are exploring the possibility that perhaps only a small percentage of equipments need meet the most stringent specifications and that some of these may be eliminated for the remainder. If so, this would provide a basis for markedly reduced production costs.

The factor of optimum requirements for equipment is responsible, in my opinion—more than any other factor—for today's high total cost of communications-electronics equipment. I am sure that the cost of communications-electronics equipment can be reduced appreciably if the Army is willing to accept certain compromises.

Any significant reduction in costs requires an integrated over-all approach—involving an examination of not only our Research and Development activities but how these relate to production costs.

Various aspects of our Research and Development activities have far-reaching implications upon costs when any R & D item goes into production. Consequently, in the development stage, it is imperative that all items or equipment be fully considered from the standpoint of economical design and economical producibility. It is also imperative that we have definite information on costs at the time any equipment is being considered for standardization, and for eventual large-scale procurement.

If we are to establish any kind of control over costs, this information is indispensable. And, I may add, this matter of producibility and cost is of essential concern to the contractor. Excessive production costs can lead to rejection of equipment being considered for adoption—or to an undesirable reduction in number of equipments that can be procured.

In dealing with the new technology factor in increased costs, we place greatest dependence upon the critique. We have a program of this nature which we term "Product Review and Value Analysis."

End of Part I. Part II will appear next month.

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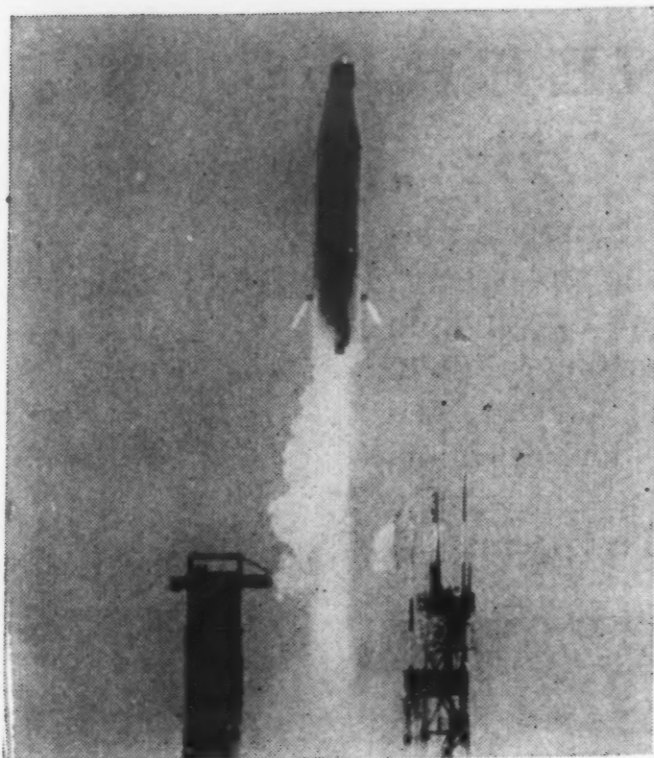


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"At the present time, about 53 per cent of our total research and development expenditures is oriented toward national security."

SCIENCE IN THE SIXTIES

by DR. ALAN T. WATERMAN

Director, National Science Foundation

IN HIS WORK ON the history of western thought, Crane Brinton comments on the impetus given by artisans to the rise of modern science. Historically it was technology that came first and supplied the tools and instruments that played a part in the rise of experimental science. Science arose when man began to extend his thinking beyond immediate practical effects, especially into the regions of generalizations and abstractions. The interaction of technology and science has been a continuing process in the last three centuries, and each plays a role in the spectacular progress made by the other. The last two decades have witnessed a remarkable acceleration in both areas, stimulated especially by wartime developments and carried rapidly forward by their own momentum.

This same period has also witnessed radical changes in the composition of what might be called the research community as well as in the reasons for which research is done.

Until about the beginning of the present century, research was largely confined to the university, where it was associated purely with teaching and the advancement of knowl-

edge. Then industry began to see the advantage of creating its own research laboratories which would provide fundamental knowledge for the furtherance of its products.

And finally, with the advent of World War II, the Federal Government became an active participant in research and development by expanding its own laboratories, but more notably through widespread contracts with universities.

New Motivations

The increase in the diversity of the research community has been accompanied by new motivations for the performance of research and development. To the desire to advance knowledge and to make fundamental discoveries of potential economic value have been added the large-scale research efforts directed toward the conquest of disease and to the national defense.

The growth in the number of groups performing research and development and in the reasons for doing so have combined to bring about great increases in the sums available for research and development, which last year reached an

estimated national total of \$12.5 billion, and to which another billion is being added in 1961.

Superimposed upon these circumstances we have an international political scene that engenders an intensely competitive situation with respect to science and technology. Thus we stand at the threshold of a decade dominated by science as no other era has been except, perhaps, the Seventeenth Century, when the impact of science caused John Donne to exclaim, "And new philosophy calls all in doubt." With what opportunities and what problems does this situation present us?

New Breakthroughs Ahead

It is, of course, impossible to predict discoveries that may lie ahead in science, but the knowledge that we have acquired in recent years, coupled with a whole array of spectacular new instrumentation, insures that important breakthroughs will occur in a number of significant fields. Starting with the macrocosm and working our way through the gross phenomena of our universe and our environment to the subatomic world of nuclei and particles, we see that we

are acquiring new knowledge at an ever accelerating pace. New tools and techniques are giving us new insights and the old hard and fast classifications of knowledge into separate disciplines are gradually giving way as piece after piece falls into place in what seems to be the grand symmetry of nature.

In astronomy the development of image amplifiers and radio telescopes has enabled us to acquire new knowledge of distant galaxies as well as of our own. On the basis of work that is now being done, there is reason to hope that within the next five years astronomers will be able to place a telescope of the order of 36 inches into orbit, and within ten years, perhaps, one of 50 inches or larger. On a somewhat longer time scale, astronomers are planning how to put a radio telescope in space far beyond the radio interference being generated on an ever-increasing scale both on the earth and by man-made satellites. As we escape from the obscuring factors in the earth's atmosphere, it is highly probable that the next decade will provide many new data that will help us to decide between alternative theories of the creation of the universe. Space research is also certain to shed novel light on the nature of life itself, particularly if we are able to bring back samples of living systems, say from some planet.

Success of the IGY

The highly successful International Geophysical Year, during which a vast accumulation of synoptic data was acquired, has added to our knowledge of the atmospheric sciences as well as calling attention to gaps in our knowledge in such important fields as oceanography and seismology. The natural phenomena associated with these fields are so complex that in the past we have been unable to do much about them. Now the availability of the weather satellites and high-speed computers makes it far more possible to handle these problems. It was Von Neumann's vision that the circulation of the atmosphere could be made amenable to calculations by means of the computer.

The construction of new oceanographic research vessels equipped with the latest instrumentation is the beginning of a massive attack on problems of both physical and biological oceanography.

The conclusion of the Antarctic Treaty, which makes this special portion of the earth's surface in effect

a scientific research laboratory, is a triumph for international relations as well as for science; it demonstrates that science is an effective force for cooperation and good will among nations. In the post-IGY period, studies have been expanded to include, in addition to the acquisition of synoptic data, individual research projects in fields not included in the IGY: biology, geology, and cartography. Within the next ten years the over-all mapping of the Antarctic should be completed and we shall undoubtedly learn the shape and nature of the continent under the ice. We shall know whether the snow and ice are increasing or decreasing, and we shall progress in understanding the heat and water budget of the Antarctic. We should have a good delineation of atmospheric problems and those relating to the earth's magnetic field as a result of international studies in both polar regions but especially the Antarctic. Biologists are finding many new kinds and varieties of life in the Antarctic, especially bacteria and single-cell creatures. In fact, they are stepping back a century to do basic taxonomy and ecology in relation to these new creatures. And finally, we shall probably know what practical use, if any, can be made of the Antarctic.

In the life sciences, we find that we are able to analyze the problems in a way that would not have been possible a generation ago. Such techniques as chromatography and the use of the ultracentrifuge, electron microscope, and so on, have made it possible to apply to living matter, more quantitative measurement. At the point where men acquired the ability to isolate and manipulate giant molecules, whole new worlds of biological research were opened up and molecular biology came into being. Chemists, physicists, and even the mathematicians began to find problems in the life sciences interesting, and the application of techniques from these disciplines has revealed new avenues of exploration. We are learning a great deal about such basic questions as how life is formed, how energy is used and stored, and how an organism duplicates itself. Pauling's work with sickle cell anemia disclosed the link between molecular variations and certain types of disease. Fundamental knowledge of this brings us much closer to the control of certain diseases. It is of interest to note, I think, that the Sloan Kettering Institute recently announced that it is shifting

its emphasis to very basic studies in molecular biology in the effort to discover the underlying cause of cancer.

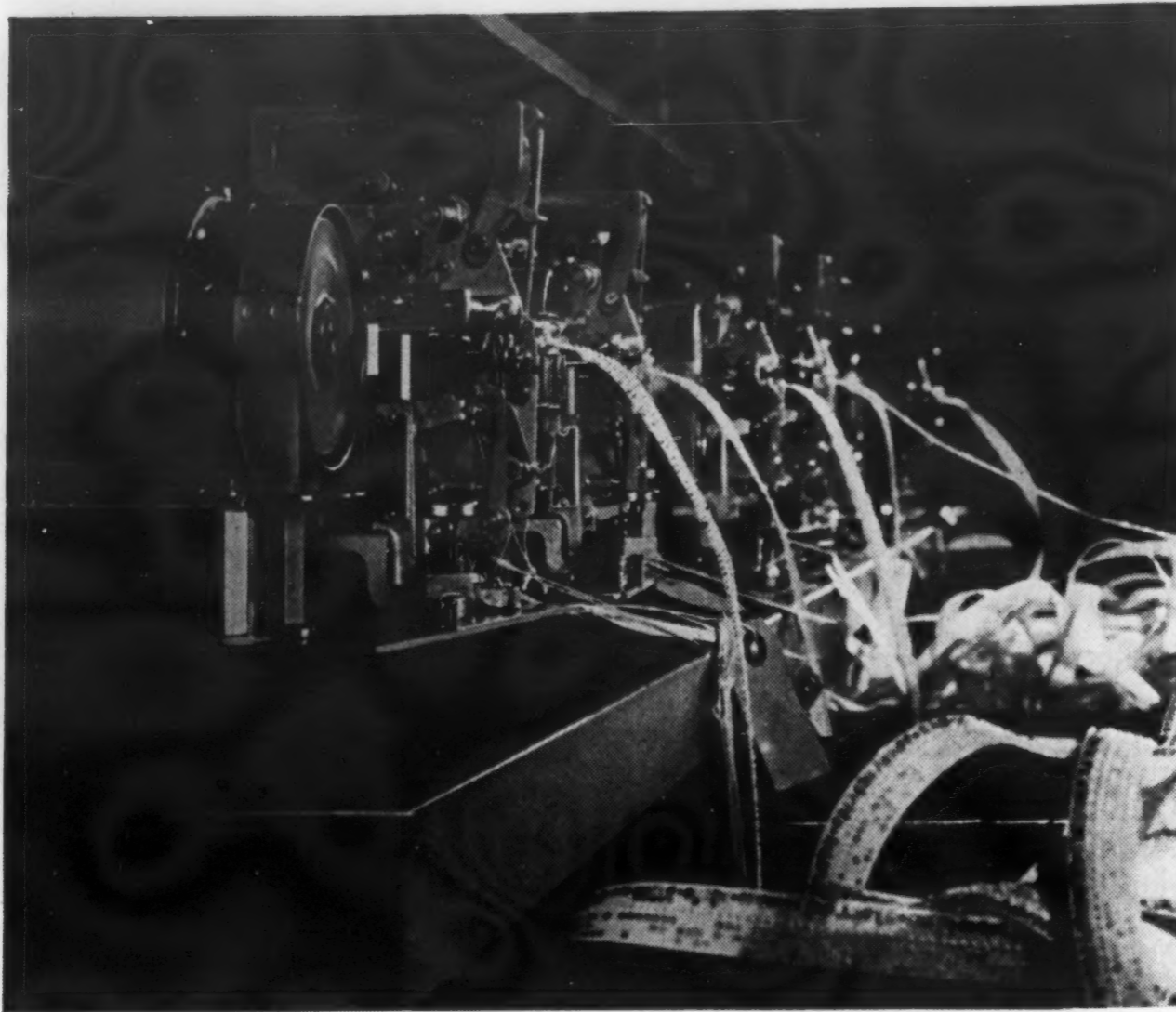
At the atomic and subatomic levels at which the physicists work, our recently acquired ability to achieve super energies makes possible more intensive search for information concerning elementary particles and the laws of force at extremely small distances. Because of the success of the Brookhaven and CERN accelerators, now operating around 33 billion electron volts, physicists have become optimistic about the possibility of achieving several hundred billion electron volts.

Neutrino Physics

Another aspect of nuclear physics which is attracting great interest at the present time is what is coming to be called "neutrino physics." The neutrino is the smallest known particle. It has no charge, so it penetrates matter very readily. It was originally postulated to satisfy the conservation of momentum in nuclear reactions and later its existence was confirmed experimentally. Nuclear reactors constitute the most copious source of neutrinos and an international race is on to study them. Physicists suspect there may be two kinds of neutrinos, and this is a subject of considerable interest. Among the questions which physicists would like to have answered is whether the neutrinos that come from nuclear reactors are identical with neutrinos associated with cosmic rays and those found in accelerator experiments.

Another trend in physics is the rebirth of interest in atomic physics, stimulated by the modern availability of mesons—the "heavy" electrons produced in accelerator reaction and by cosmic rays. These are now available in such abundance that experiments are being performed in which mesons may be substituted for ordinary electrons. This new tool permits a whole new study of energy levels in the atom. It may be some years before the full significance of such research becomes evident.

Still another area in which there is great interest is the field of micro-miniaturization. Ever since it was observed that biological organisms perform certain functions much more efficiently than machines, and in a very much smaller space, scientists have been interested in the laws of similitude. It has been found useful to test those laws by examining things that are very large or very small. Studies of solid-state physics, which



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produced the transistor and gave such impetus to miniaturization, now makes it potentially possible to design materials which will allow the construction of whole instruments in a speck of matter. This process, which is also known as molecular or crystal engineering, has almost limitless applications. A little over a year ago Dr. Richard Feynman offered \$1,000 to the first man who would make an operating electric motor, to be controlled from the outside, that would not exceed a 1/64th inch cube in volume, not counting the lead-in wires. Not many months later a young engineer collected the prize for constructing a motor six one-thousandths of an inch in diameter. This novel feat suggests the rate at which the techniques of science are advancing.

As one progresses from the physical sciences through the life sciences and the social sciences, there is an ascending order of difficulty in the problems to be solved. The great progress made by the physical sciences is undoubtedly due to the fact that its problems are simpler and more amenable to laboratory experimentation. In the life sciences the problems are much more difficult; but as we have noted, these are gradually yielding to new methods and instruments, many of which have been supplied by the physical sciences.

It is in the social sciences where we find the problems which are least susceptible to laboratory experimentation. However, the advent of the computer now makes possible an approach to the permutations and combinations that abound in social situations. The computer makes possible the construction of much more complex models than have hitherto been available. By a combination of the survey and computer simulation of social processes, scientists have a technique which can in effect perform some experiments in such complex fields as economics, sociology, and human-problem solving.

The National Science Board has recently taken action to accord the Foundation's Office of Social Sciences the status of a full division, co-equal with the Division of Biological and Medical Sciences and the Division of Mathematical, Physical, and Engineering Sciences. This action reflects not only our conviction of the importance of the social sciences but our faith in their increasing ability to apply scientific methods to the solution of some of the most pressing issues of our time.

(Continued on page 42)

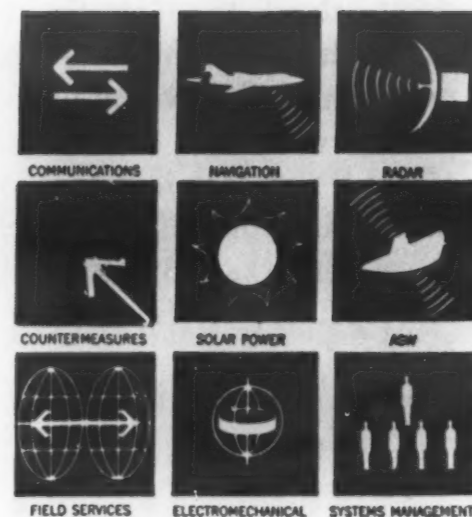


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The postwar period will undoubtedly be remembered, among other things, as a period in which the trend toward bringing together a variety of specialists to work on problems of common interest received great impetus. One of the interesting developments arising out of this trend is the Center for Communication Sciences at M.I.T. The Center brings together electrical engineers, mathematicians, neurophysiologists, linguists, and others to study the complex phenomena associated with information-generating and processing systems. This new activity, which is actually a combination of related activities, has important implications for a number of fields ranging all the way from the design and construction of devices for the transmission of signals by various media to neurophysiology and experimental psychology.

As one reviews the current status of science even casually, it is quite apparent that each field, as well as the convergent fields where two or more disciplines come together, offers exciting promise for the future. One is tempted to dwell on this aspect of the matter, for it is pleasant to contemplate the pursuit of truth divorced from the pressures that crowd upon us from every side. The realities of today's world are such, however, that we find we are not free to devote all our intellectual and material resources to the pursuit of knowledge for its own sake, nor even to the pursuit of knowledge for the simple motive of improving our industrial capacity.

At the present time, about 53 per cent of our total research and development expenditures is oriented toward national security. Included are expenditures by the Department of Defense and the Atomic Energy Commission. Over the past decade the Department of Defense alone has accounted for an average of 75 per cent of the total Federal obligations for research and development. Thus when we analyze the greatly augmented funds that have become available for research and development in recent years, we find that actually only about 8 per cent is going for the very basic kind of studies touched on in these remarks. Breaking these down still further, we find that part of the funds for basic research are earmarked for activities related to specific missions or objectives, so that in the final analysis only a small proportion of our over-all expenditures goes for research at the very frontiers of science.

At the moment there seems to be no way out of our present dilemma. The long stalemate on world disarmament gives little reason to hope that we can relax our efforts in defense research in the foreseeable future. It is sometimes said that the solution should come from the social sciences. My own view is that although the study of sociology should be encouraged and supported, research in this highly complex field is hardly likely to come up with practical answers as rapidly as they are needed. Indeed, no single discipline will do this; but all disciplines are potentially able to contribute. The whole history of science demonstrates that the solution of a perplexing problem quite often comes from a totally unexpected source; and oftener still, a discovery in one field turns out to have far greater significance in another, just as Roentgen's discovery has so profoundly influenced the course of modern medicine.

We have already seen that the application of the physical sciences, in the development of the computer to its present high level of performance, has contributed an important tool which enables the social sciences to reduce some of their complex problems to more manageable proportions.

The war saw the development of operations research into a novel technique important in the study of complex operational problems. This technique brought together such differing specialists as mathematicians, physicists, chemists, economists and biologists. In a similar but more conventional manner, emphasizing the role of the engineer, systems analysis has shown its great value in development and production planning. Thus science is taking important steps in solving some of the technological difficulties it creates.

Support of Basic Research

Whether our present goal is to develop national strength or to help solve some of the fundamental environmental problems facing mankind, it seems abundantly clear that our safest and most rewarding course is to encourage and support basic research as fully as possible over the entire spectrum of knowledge. It is only in this way that we can uncover the full potentialities of science and increase the probability of completely new and revolutionary findings. Furthermore, this approach is most feasible and most effective in a free society like ours. If we do this we should simultaneously concentrate upon (1)

the study of basic research findings for possible useful applications; (2) the feasibility of such items for development and their relation to priority goals; (3) careful selection of those items for development and production that will help attain our goals and which we can afford—in money and effort—to undertake.

If one were to consider the progress of science and technology from the standpoint of fundamental physical laws, there are interesting parallels. The first law of thermodynamics surely applies. No energy is lost; sound research endures and is never without value—even research devoted to military ends. Of course, the process is not 100 per cent efficient—there is friction and waste motion, resulting in heat and sound, and occasionally light! Which reminds us that the second law of thermodynamics also applies: what we are really doing is trying to decrease the entropy of the system. Organized science represents potential, available energy or power. To obtain such a local decrease in entropy requires the expenditure of energy, and the process is far from being an efficient one, even in purely physical systems. While on the subject, we should perhaps remind ourselves that, in so far as we know, the over-all change in entropy must be an increase.

To conclude on a serious note: all nations are convinced that their future is bound up closely with their progress and capability in science and technology. Among modern nations this capability is becoming general. Grim competition has developed along both military and economic lines. Into this scene there enters a host of emerging nations, small and large, impatient to acquire the standards of living and the independence associated with science and technology. To solve these two major problems and maintain any kind of equilibrium will require the utmost of all participants.

As if this were not enough, science is now bringing in discoveries of graver and graver social significance. This trend is bound to continue and indeed to accelerate. To paraphrase a familiar expression: We have hardly seen anything thus far! Whether future developments take the form of stupendous power over nature's resources, of influence and control over life or over men's minds, or of traffic with our sister planets, they will in all probability raise problems of such concern to the human race that mankind must—repeat *must*—learn to cooperate in their solution.

"ENGINEERING's Latest Hot Potato" is how Dr. S. W. Herwald, Westinghouse Vice President for Research, recently described direct energy conversion. Although there may be few engineers and scientists working in this new technology who will dispute this description, the underlying principles of direct energy conversion were discovered more than a hundred years ago.

Direct conversion involves the change of a source of energy—chemical, solar, or nuclear—directly into electricity. With conventional methods of generating electricity, the energy provided by combustion or water pressure is first transformed into the mechanical energy of a spinning shaft and electric current is generated in a coil of wire that rotates between the poles of a magnet. The principle of the dynamo was discovered by Michael Faraday about 130 years ago, and is put to use in one of the new direct conversion devices, the magnetohydrodynamic or MHD generator.

The impetus for this new technology has come from today's growing need by military and space programs for light-weight, reliable, compact and static (no moving parts) power sources. Direct-conversion units answer this description, with the MHD generator an exception at this time; the people working on MHD generators are talking about power units in the megawatt range.

Lightness and lack of moving parts make these unconventional or "exotic" power packages valuable for the space program, where it takes pounds of thrust—and many dollars—to lift every ounce. Absence of moving parts adds two important advantages for military applications: silence and low maintenance. Some idea of just how essential they are considered by the Department of Defense is given by the fact that direct energy conversion is a multimillion dollar research and development program within DOD.

Four energy conversion devices are receiving the majority of R & D attention today: photovoltaic or solar cells, fuel cells, thermoelectric generators and thermionic converters. All are d-c devices; for applications where a-c is desired, static inverters are available. Research and development is going ahead on MHD at Westinghouse, Avco and Martin, but there are extremely difficult high-temperature-materials problems to be solved in this area.

Like transistors, both solar cells and thermoelectric generators use

by CHARLES DEVORE
Vice President
CREI Atomics
The Capitol Radio Engineering Institute

Direct Energy Conversion

Dr. J. W. Coltman, manager of the electronics and nuclear physics department at the Westinghouse research laboratories, demonstrates an experimental thermionic tube. Within the tube, a glowing wire emits electrons, causing current to flow in ionized cesium gas. Dr. Coltman points to the cesium capsule at the base of the tube.



semiconductor materials. Such materials may be of two types: an N-type, with an excess of negative charges, or electrons, and a P-type, with an excess of positive charges, or "holes." An electrical current flow is generated when these materials are properly selected and joined together and activated by either light or heat.

Fuel cells are similar to storage batteries, but do not have to be recharged. And thermionic converters, as the name suggests, make use of the principles of thermionic emission inherent in the electric light bulb and thermionic or electron tube.

For the sake of completeness, an MHD generator is similar to a conventional generator, but substitutes a moving, heated, ionized gas for the moving, copper conductor to produce an electric current. Because they appear to be limited to large-scale power units, we shall not include MHD generators in this discussion.

Solar Cells

Solar cells are the most highly developed of the new power sources today. Hoffman Electronics and a few other companies are marketing small cells (1 x 2 cm.) under Bell Telephone Laboratories patents, with most of them being used in the Nation's space program. Such cells represent the best available means of

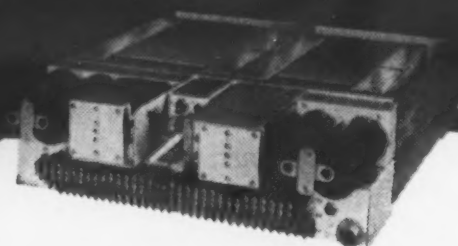
providing small amounts of power for satellite applications, but they are limited to small power supplies because of their weight—on the order of one pound per watt of power output. The best projected figure for a power supply using existing solar cell techniques is 120 pounds per kilowatt, which is still much too heavy for satellites. But solar cells are reliable and operate indefinitely with no loss in efficiency—Vanguard I, orbited in early 1958, is still transmitting. More recent applications of solar cells for satellite communications have incorporated a time switch for shutting off transmission after the desired interval.

According to theory, as much as 25 per cent of the incident radiation—sunlight or artificial light—can be converted to electricity. Under certain conditions, it is believed that this figure can be raised to 40 per cent. The best reported from the laboratory, however, is 14 per cent. Substantial production quantities that can be obtained give a 10 per cent conversion efficiency. Offsetting this low efficiency is the fact that the fuel—sunlight—is free and inexhaustible.

The most familiar form of solar cell uses silicon, treated or "doped" with impurities to secure the desired operation. Most of the research effort

(Continued on page 88)

- improved performance and characteristics
- decreased size, weight and power consumption
- functional replacements for Military types TD97 and TD98



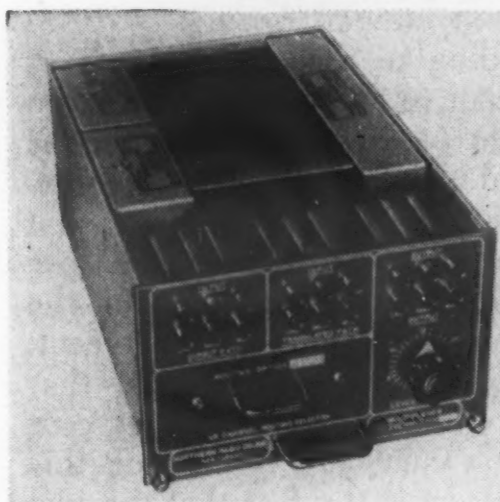
Rear view of a Multiplexer-Demultiplexer Shelf, Type 250 Model 1, showing 2 Transistorized Power Suppliers and Changeover Relay.



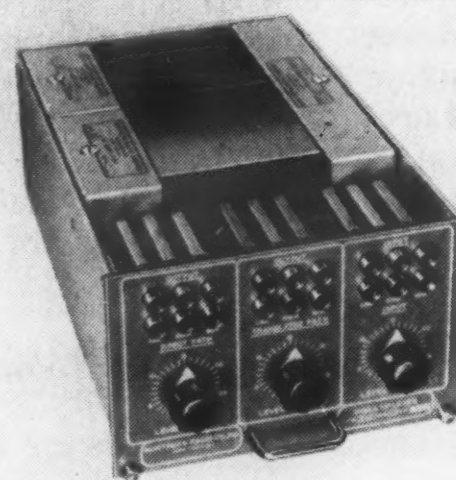
New ALL-TRANSISTOR NORTHERN RADIO MULTIPLEXER and DEMULTIPLEXER Type 248 Model 1 Type 249 Model 1

The new Multiplexer, Type 248 Model 1 (functional replacement for Multiplexer TD97-FTG-2), and Demultiplexer, Type 249 Model 1 (functional replacement for Demultiplexer TD98-FGR-3) are intended for use with twin-channel, single-sideband radio circuits operating in the high-frequency range. Their purpose is to derive two voice-frequency circuits from each of the radio channels. By means of frequency division multiplexing, the radio bandwidth from 200 to 6000 cps is divided into two transmission circuits, each with a bandwidth from 375 to 3025 cps. Four such vf circuits are derived from the twin-channel radio, and these are used to transmit carrier telegraph signals or to provide telephone or facsimile service.

The Multiplexer and Demultiplexer are designed to slide into the Northern Radio Type 250 Model 1 Shelf, which accommodates two each Multiplexers or Demultiplexers, or one each Multiplexer and Demultiplexer.



Two Multiplexers, Type 248 Model 1, are required for full utilization of the capacity of a radio transmitter. One is used to transmit telegraph, telephone, or facsimile signals from two vf circuits to the radio channel designated as sideband A. The second Multiplexer performs the same function for sideband B. In this way four vf circuits are applied to the twin-channel radio transmitter.



Two Demultiplexers, Type 249 Model 1, are required for full utilization of the capacity of a radio receiver. One is used to receive telegraph, telephone, or facsimile signals for two vf circuits from the radio channel designated as sideband A. The second Demultiplexer performs the same function for sideband B. In this way four vf circuits are derived from the twin-channel radio receiver.



The Multiplexer and Demultiplexer are transistorized equipments, including necessary bandpass filters, line amplifiers, carrier frequency sources, modulators and attenuators. The Multiplexer requires a nominal 14 volts DC at 125 milliamperes; the Demultiplexer, approximately 200 milliamperes at the same voltage. The power supply is normally provided from the Northern Radio Power Supply, Type 223 Model 1, which is plugged into the rear of the Type 250 Model 1 Shelf.

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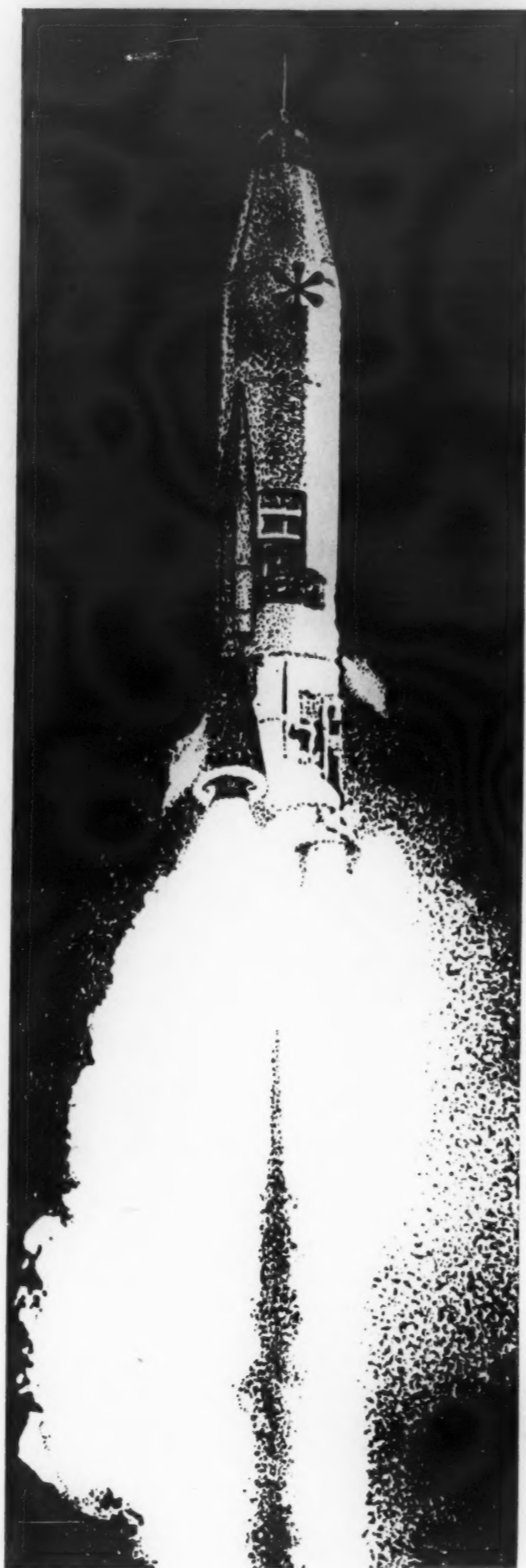
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Editor's note: As commander of the new Air Force Systems Command at Andrews AFB, Md., Lieutenant General Bernard A. Schriever has responsibility for managing the acquisition of Air Force system programs from development, test and production through installation and checkout. The mission of the Air Force Systems Command is to deliver complete, timely and operable systems to using commands such as the Strategic Air Command, the Tactical Air Command and the Air Defense Command. Established April 1, the new organization is made up of elements of two former commands, the Air Research and Development Command, which General Schriever previously headed, and the Air Materiel Command.

Four new divisions and six former ARDC centers have been assigned to the new command. The Ballistic Systems Division, in Los Angeles, Calif., which is composed of elements of the former ARDC Ballistic Missile Division and AMC's Ballistic Missile Center, is responsible for the Atlas, Titan and Minuteman ICBM programs. The Space Systems Division in Los Angeles, Calif., also formed from elements of ARDC's Ballistic Missile Division and AMC's Ballistic Missile Center, is charged with the military space programs assigned to the Air Force and has responsibility for certain development projects in support of Army, Navy and the National Aeronautics and Space Administration. Composed of ARDC's Wright Air Development Division and a major portion of AMC's Aeronautical Systems Center, the Aeronautical Systems Division in Dayton, Ohio, will do work on such programs as the new C-141 jet transport, Skybolt air-launched ballistic missile, and Dyna Soar manned space vehicle. Combination of ARDC's Command and Control Development Division and AMC's Electronics Systems Center forms the Electronics Systems Division in Bedford, Mass. The acquisition of Ballistic Missile Early Warning System and the NORAD Air Defense Control System are included in this division's responsibilities. The Rome Air Development Center also is assigned to this division.

The six former ARDC centers included in the new command are: Air Force Missile Test Center, Patrick



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AFB, Fla.; Air Proving Ground Center, Eglin AFB, Fla.; Arnold Engineering Development Center, Tullahoma, Tenn.; Air Force Missile Development Center, Holloman AFB, N. M.; Air Force Special Weapons Center, Kirtland AFB, N. M.; Air Force Flight Test Center, Edwards AFB, Calif.

A new name has been given to the Air Force command which will operate the USAF's global Aerospace Communications Complex. Scheduled

now with startling regularity. Man has made more progress in the last decade, technologically speaking, than in all the previous years of history. I expect the same sort of prog-

MINIATURIZATION AND SPACE

by
LT. GEN. BERNARD A. SCHRIEVER
 Commander
 Air Force Systems Command
 Andrews AFB, Md.

to be activated July 1 at Scott AFB, the new organization will be called the Air Force Communications Command. Previous announcements had listed, first, "Air Force Communications Service" and then "USAF Communications Service" as the official title for the new command. In announcing the name change General Thomas D. White, Air Force Chief of Staff, noted that "Air Force Communications Command" better reflects the magnitude of the responsibilities being assigned the new organization; and that use of the term "Command" is more appropriate to the global communications responsibilities of the new organization in operating the world-wide Air Force components of the Defense Communications System.

Major General Harold W. Grant, presently Director of Telecommunications, Hq USAF, was named by General White last February to be the first Commander of the Air Force Communications Command. The new command will assume all responsibilities now assigned to the Airways and Air Communications Service. The command also will be assigned communications responsibilities of other major commands over a two-year period.

A third new Air Force command has been announced. The Air Force Logistics Command, located at Wright-Patterson AFB, Ohio, has assumed responsibility for most of the work formerly done by the Air Materiel Command. General Samuel E. Anderson, who commanded the AMC, is the commander of this new organization.

WE ARE LIVING IN an age of exploding technology. Scientific and technical breakthroughs of the type that used to occur every century or so, and then every decade or so, appear

ress in the next decade and in those to come.

Militarily speaking, this outburst of creative technology started about the end of World War II with the

development of ballistic rockets and nuclear weapons. These developments, when combined, changed our concepts of life and security. For the first time in the history of our country, we are vulnerable to a massive destructive surprise attack. This is but one of the results brought about by the ever-increasing rate of technology. At the same time, we possess a counter-offensive deterrent force, unparalleled in history, brought about by the same technology.

New scientific and engineering advances bring with them new problems. In the broad spectrum of competition we are in with the Communist world, the relative positions of our Free World and Communist technology are vital to our future. True technological surprise could place the loser in a position from which he might find it most difficult, if not impossible, to recover. For example, if the Communists were to develop an effective anti-ICBM before we do, they would have a tremendous advantage.

To keep ahead in this aerospace age, military research and development must continually push back the horizons of technological knowledge in many areas simultaneously. We must work against the clock searching out new scientific and engineering advances from which we can develop the most useful military systems and we must insure, insofar as possible, that we are not surprised technologically.

Three Types of Deterrent Capability

The composition of that deterrent capability falls into three general categories. The first category is that of air breathing vehicles operating at both subsonic and supersonic speeds. This force represents the major part of today's capability. However, the technological strides of the Communist world have dictated maximum operational readiness of the second category of our deterrent capability—ballistic missiles—at the earliest possible time.

Ballistic missiles are entering our inventory and at an increasing rate. That is a prosaic statement which covers a modern miracle. When you consider that in 1954 we had nothing but the judgment of a group of scientists that the ICBM was a technical feasibility, it is a tribute to the people of this country that we have literally created a whole new technology which has transformed an idea into reality in a few short years.

However, the fact that the Com-

munists can also achieve global ranges with these new weapons plus the fact that we, not they, must be concerned with the element of surprise, make it mandatory that we press on into the third category of aerospace forces. This category encompasses a range of vehicles that will have capability from suborbital to orbital to escape velocities. If we are to guard ourselves from the element of global surprise and at the same time provide a capability of effective command and control over our counteroffensive forces, it is mandatory that we make use of space. We must utilize space for worldwide warning, and as a means of instantaneous reliable communications for command and control on a global basis, and as a means of accelerating our national decision-making capability.

The tools of freedom represented by the three categories of aerospace forces I have described should be of particular interest to the electronics and communications industries because of the role which these industries have played in each category.

Military Space Systems

Progress is being made in the development of military space systems. Remember that it was only three and one-half years ago that the first man-made satellite was placed into orbit. Since that time, there have been literally dozens of satellites and we have come to accept rocket aircraft, ballistic missiles and satellites as parts of our daily life. New satellites today create only a ripple of interest in the public press. I mention these things only as a reminder of how far we have come in the last few years.

Without the contributions of miniaturization, our space programs would not have been possible. Recently, I read an article by Mr. Frank A. Glassow, the vice chairman, Electronic Technical Committee of the Aerospace Industries Association. He wrote, "What would the electronic profile of our Pioneer V or Able-3 satellites have been if they had existed ten years ago? The answer to this question might well explain the Russians' superior capability for placing heavy payloads into orbit. Their early plan to exploit space probably led to the development of much larger rocket engines and boosters for orbiting the heavier and bulkier electronic payloads characteristic of the early fifties. Conversely, because of our greater number of smaller satellites in orbit, we might also conclude that we are consider-

ably ahead of the Russians in producing small, lightweight electronic payloads."

While I do not necessarily agree with the reasons given by Mr. Glassow, I am convinced that our programs would not have been possible without the job which was done in the field of miniaturization. As an example of the progress being made in miniaturization, Mr. Glassow stated, "Perhaps the greatest single electronic event during the past ten years has been the development of the transistor. In 1950 our most miniaturized electronic equipment was based on the sub-miniature vacuum tube. Had vacuum tubes been used exclusively for the receiving coding, storing, power conversion and commutating functions performed in Pioneer or Able, the 95-pound payload would have been exceeded by at least fivefold just to carry the bulk of equipment."

Now, I think it is fair to ask the question now of what the future holds. Although most crystal balls are cloudy at best, I would like to discuss some of the things we believe will be important.

In 1957, I said to an electronics group, "Perhaps some of you might be interested in a few of the specific areas in electronics which some of my staff believes are particularly worthy of attention for future Air Force application. I might mention continued emphasis on solid state devices, particularly with regard to quality control in manufacturing and to reliability in application. Improved and more accurate instrumentation for missiles and satellite flights, improved packaging for high static and vibration environment and lightweight electronics associated with gyros and inertial systems are needed also. Further work on data extraction devices, and those whose purpose is to convert information from analog to digital form, would be worthwhile. Since the interest in mouse traps has begun to wane, the world would probably beat a path to the door of someone who built a really outstanding accelerometer, most particularly if he could do it for a reasonable price."

While we have made great strides since 1957, I believe that these things are worthy of continued attention. Still much progress has been made and new areas have been uncovered.

Reliability and Bionics

There is a new technical area now emerging as a major field of interest

(Continued on page 48)

30

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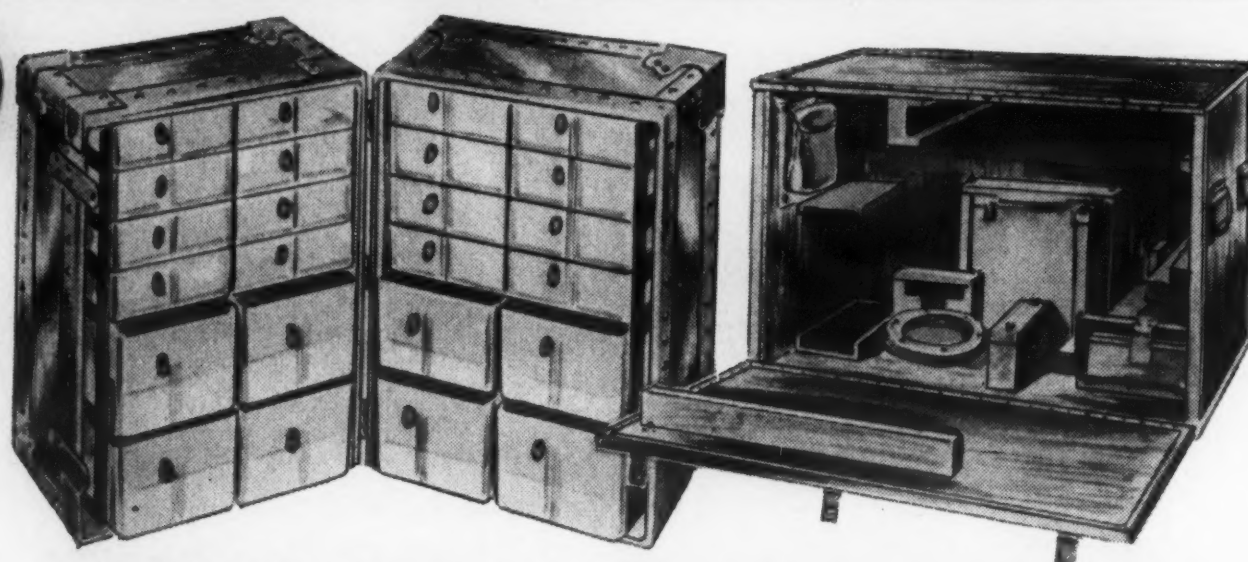
... research, development & manufacturers of specialized electronic equipment

to my command. The Air Force has always been concerned with reliability. We are now interested in the reliability that can be achieved in electronic and servo subsystems by patterning their functions on the behavior of living organisms. Last September it was my privilege to address a symposium at the Wright Air Development Division in Dayton, Ohio, convened to explore this new area of technology—Bionics. As I stated at that meeting, when we consider that the human brain contains at least a thousand billion neural elements, we can understand that these may provide models leading to significant contributions to miniaturization. This is a goal which deserves our utmost efforts; for under these conditions, such mishaps as total catastrophic failure could become a thing of the past. If we analyze how living mechanisms operate, we see that although they can be damaged, in the majority of cases, operation is still possible. While this means degraded functioning, if the threshold is high enough, it is operational none-the-less. This philosophy can mean significant improvement in the total reliability of our missile and space systems.

When such concepts were postulated in the pre-missile and pre-satellite era, they were not readily accepted. Reliability was based on the availability of an adequate maintenance environment. We must think in terms of the new requirement for space systems. Reliability must take on a new meaning. We are interested in satellite systems having at least an 8000-hour operable life with zero maintenance. This will place heavy demands on industry, both in the areas of miniaturization and reliability.

Another area in which significant advances have been made is the molecular electronics programs. Today these programs are evolving from the early beginnings of little more than sophisticated, integrated circuits to the point where we are now employing the basic characteristics of the materials to provide electronic functions.

The lessons of the past should make it clear that unparalleled opportunities await us in the age of space. I personally believe that the immediate future will be both the most exciting and most challenging era ever faced by man. It is an era ripe for progress, but remember the words of the slogan "The future belongs to those who prepare for it."



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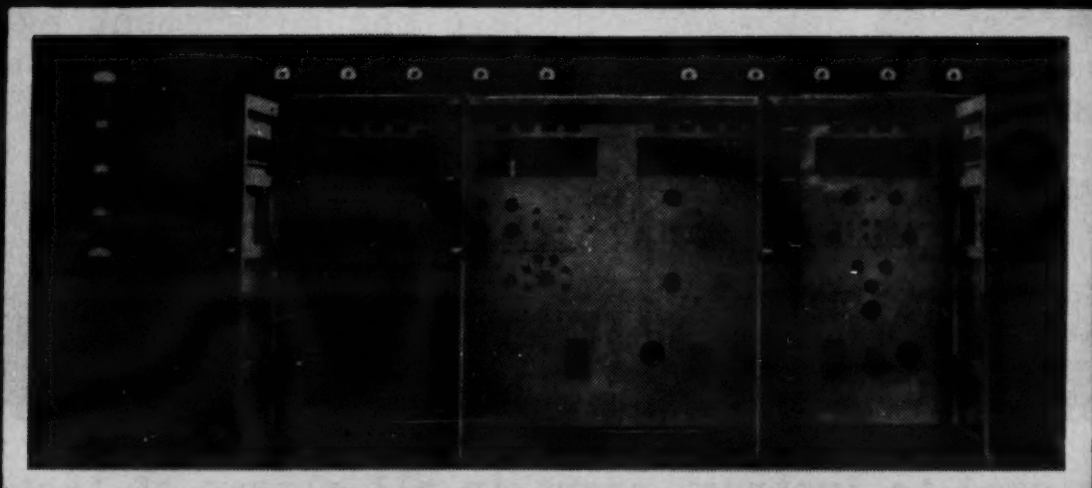
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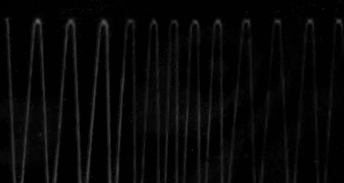
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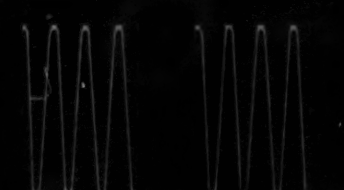
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SIGNAL·GRAM

—GOVERNMENT—

NASA BUDGET REVISIONS call for 11.3 percent increase in authorizations for fiscal year 1962, bringing the total to \$1,235,300,000. Expenditures are being raised to \$1,050,000,000, which is an 8.8 percent increase over the budget request submitted last January. The additional funds, contained in the budget message President Kennedy submitted to Congress, March 28, will be used "to speed up the booster and propulsion components necessary for further development of both manned and unmanned exploration of space . . . This includes increased launch facilities."

INDUSTRY FINANCING OF R&D COSTS for a communications satellite program is being postponed, NASA officials stated at a press conference, March 28. Government financing is being provided under \$10 million additional funds in the budget. NASA Administrator James Webb believes "it was not fair to private industry to ask them to assume risks which were unknown at this time." The Government will take a "good hard look" at the possibility of industry financing of communications satellites "before making commitments," according to Mr. Webb.

UNIFIED TELECOMMUNICATIONS SYSTEM for civilian agencies of government will be established within the next three years, according to a joint announcement by the General Services Administration and the Office of Civil and Defense Mobilization. The system, to be known as the Federal Telecommunications System (FTS) and administered by the General Services Administration, is designed to serve the government agencies more efficiently and economically on a day-to-day basis. The FTS will connect some 8,000 government offices in approximately 1,750 cities and towns. It will include voice, teletypewriter, data and facsimile services and will be interconnected with military and commercial systems.

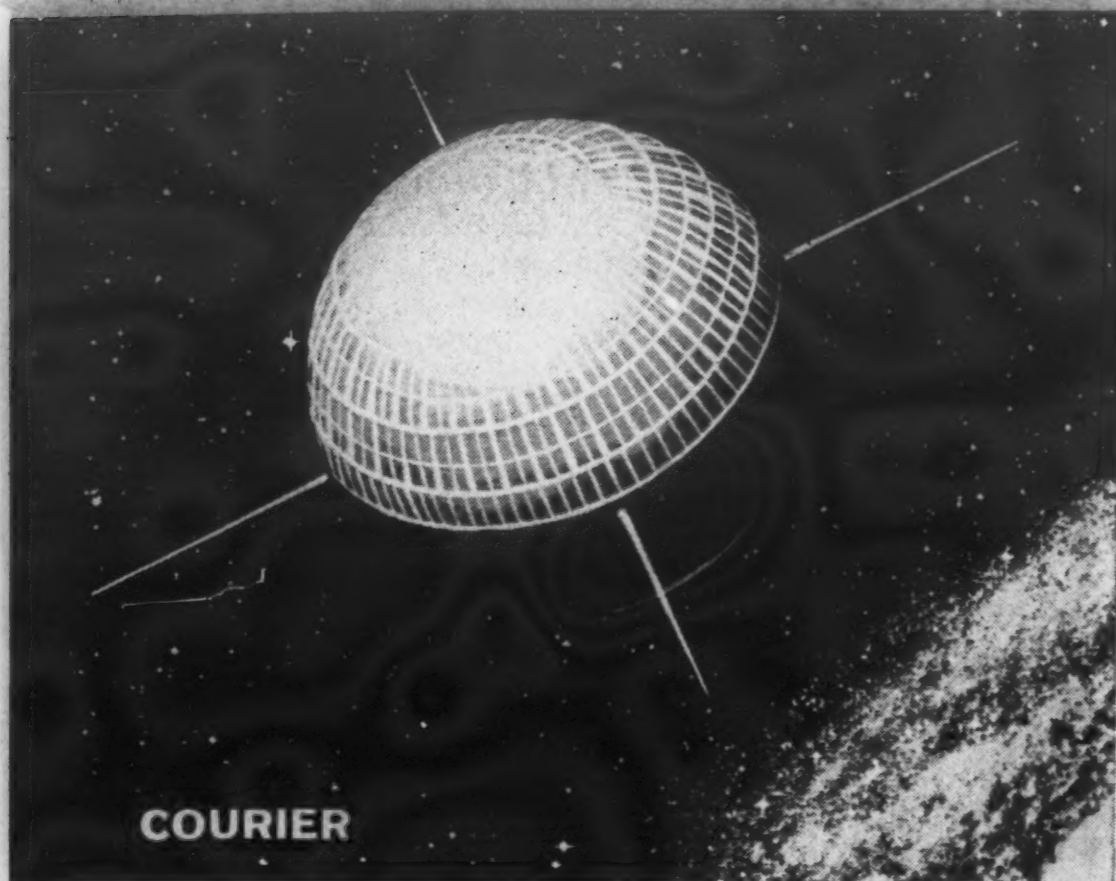
HELICOPTER TRAINING DEVICE that duplicates the full performance range of the all-weather HSS-2 Sikorsky helicopter has been delivered to the Navy Dept. by Melpar, Inc. who designed and built the device. The HSS-2, equipped with the AN/AQS-10 sonar and designed as an advanced system for antisubmarine warfare, is scheduled to become operational this year. The helicopter weapons system trainer was developed under a \$3.1 million contract from the U. S. Naval Training Device Center, Office of Naval Research. The trainer will be used to instruct crews in all phases of tactical missions, including communications, navigation, antisubmarine search procedures, target tracking, detection and classification, and the delivery of weapons.

MILITARY ASSIGNMENTS of research, development and operations responsibilities for Defense Dept. satellite reconnaissance, mapping and geodetic programs were announced recently. The Air Force assumes responsibility for research, development and operation of all Defense satellite reconnaissance systems. The Air Force also is assigned responsibility for research and development of all instrumentation and equipment for processing reconnaissance data received from these satellite systems. The Army will be responsible for establishing and managing a single geodetic and mapping program, and maintaining a research and development program in basic geodetic methods. The Army also will provide specifications for the development of mapping and geodetic satellite payloads and the operational coverage required for its data collection program.

ARMY MILITARY CONSTRUCTION WORK will be consolidated in 17 of the 42 Army Engineer districts over the next several months, the Defense Dept. announced. At present 31 districts have responsibility for military construction. The General reassignment of workloads will reduce administrative costs and permit more effective use of professional engineering talent, it is said.

NAVY COMPUTER SYSTEM is being used to analyze the bids of companies competing to sell jet fuel to the Defense Dept. The new automatic data processing system is expected to save \$5 million of the annual \$400 million cost of the fuel, according to the Defense Dept. The system was developed by mathematicians and operations research analysts of the Navy Management Office and the Military Petroleum Supply Agency.

(Continued on page 52)



COURIER



DISCOVERER



MIDAS



ECHO

Philco Achievements in Space Technology

Philco has made many major contributions to the nation's vital space programs. COURIER, the world's first advanced communications satellite, was designed and built by Philco. Philco played a major role in the development and installation of the complex communications, command, tracking and data systems for the DISCOVERER program. Space-borne and ground communications systems for MIDAS and other satellites have been Philco designed. Philco developed and installed the tracking and receiving systems for the Air Force Passive Satellite Relay Link, which utilizes

the ECHO satellite. In the field of human factors engineering, Philco has developed personnel subsystems for several major space projects. Philco also produces the world's largest 3-axis satellite tracking antennas.

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LIMITED NUMBER OF COMMERCIAL SATELLITE SYSTEMS rather than many such systems appears to be what the Federal Communications Commission will recommend as the best means of providing for increased communications needs. In a notice of inquiry dated March 29, the FCC noted that "a number of industry organizations, including existing international communication common carriers" believe that "a single integrated system, or a limited number of independent systems, offers the most feasible means of successful operation within the foreseeable future. Such view appears to be based on the premise that a multiplicity of commercial satellite systems appears unlikely in view of the substantial capital investment which will be necessary, the limitations which may be required by efficient spectrum management considerations, both national and international, and a possible inability to justify economically more than a limited number of systems in the near future."

FCC IS STUDYING INDUSTRY COMMENTS to its space communications inquiry. If a single or limited number of satellite communications systems would "best serve the public interest" the FCC wants to know "what plan of participation is best designed to provide equitable access to, and non-discriminatory use of, satellite communication facilities, by existing and future international communication common carriers and others," and "should such a plan include participation of manufacturers of satellite communication and launching equipment." The Commission requested that answers to these questions be submitted by May 1.

NSF GRADUATE FELLOWSHIP AWARDS have been granted to 1537 individuals for work in fields of science, mathematics and engineering for the academic year 1961-62. The awards are made in furtherance of the National Science Foundation's policy of encouraging outstanding college graduates to obtain advanced training in the sciences on a full time basis. Of the awards, 347 were made in the life sciences, 1156 in the physical sciences, including a number in interdisciplinary fields, and 34 awards were made in certain areas of the social sciences.

CONTRACTS: ARMY: Western Electric Co., production of Nike Hercules missile, \$23.2 million; Continental Motors Corp., production of engines for M-60 tank, \$13.9 million; Capehart Corp., production of R-390 (A) radio receivers, \$2.6 million. NAVY: Grumman Aircraft Engineering Corp., production of W2F-1 Hawkeye aircraft, \$38 million; Raytheon Co., production of Sparrow III air-to-air supersonic missile system, \$28.1 million; Magnavox Co., production of antisubmarine warfare radar units, \$10.5 million; Maxson Electronics Corp., manufacture and assembly of guidance and control components for Bullpup missiles, \$1 million. AIR FORCE: Caledonia Electronics & Transformer Corp., production of reactor transformers, \$43.9 million; Infrared Industries, Inc., advanced development and production engineering of infrared detectors for the Midas system, \$1.5 million (subcontract from Lockheed Missiles and Space Div.); Radio Corporation of America, Electronic Systems Div., study contract to determine whether a BMEWS tracking radar can double as a satellite surveillance radar, \$89,000.

—INDUSTRY—

BENDIX CORP., Systems Div., has been awarded a \$17.2 million Army contract to develop the communications system for Project Advent. Project Advent's objective is to demonstrate the feasibility of a microwave communications satellite that would operate in a 24-hour synchronous equatorial orbit, receiving and amplifying radio signals and re-transmitting them to ground stations thousands of miles from their point of origin. Bendix will be responsible for the design of the satellite repeater, special purpose ground equipment, checkout equipment and the communications system engineering.

TEXAS INSTRUMENTS INC. will develop and produce universal pulse code modulation (PCM) data recording systems for use in tests of long range guided missiles and target drones over the Atlantic Missile Range. The ground equipment will process, record and display PCM data in any of the formats standardized by the Inter-Range Instrumentation Group. The equipment also will be able to process data from systems with special formats such as Minuteman and Polaris. In operation, the equipment accepts a serial PCM signal in real time from the output of a receiver, reconstructs the data as required and records it in parallel on a digital tape recorder.

TWO COMPANY MERGERS of significance were announced recently. The merger of Amphenol-Borg Electronics Corp. and FXR, Inc. was approved by their boards of directors, March 28 and will be recommended for approval by stockholders of both companies at meetings to be held this month. Under the terms of the agreement, FXR, Inc. will operate as a separate division with present management and personnel. The boards of directors of Chance Vought Corp. and Ling-Temco Electronics, Inc., have approved in principle a plan to combine those companies, subject to approval of stockholders. Plans for consolidating the companies will be presented to their respective stockholders in meetings to be held next month. A name for the new company will be announced at that time.

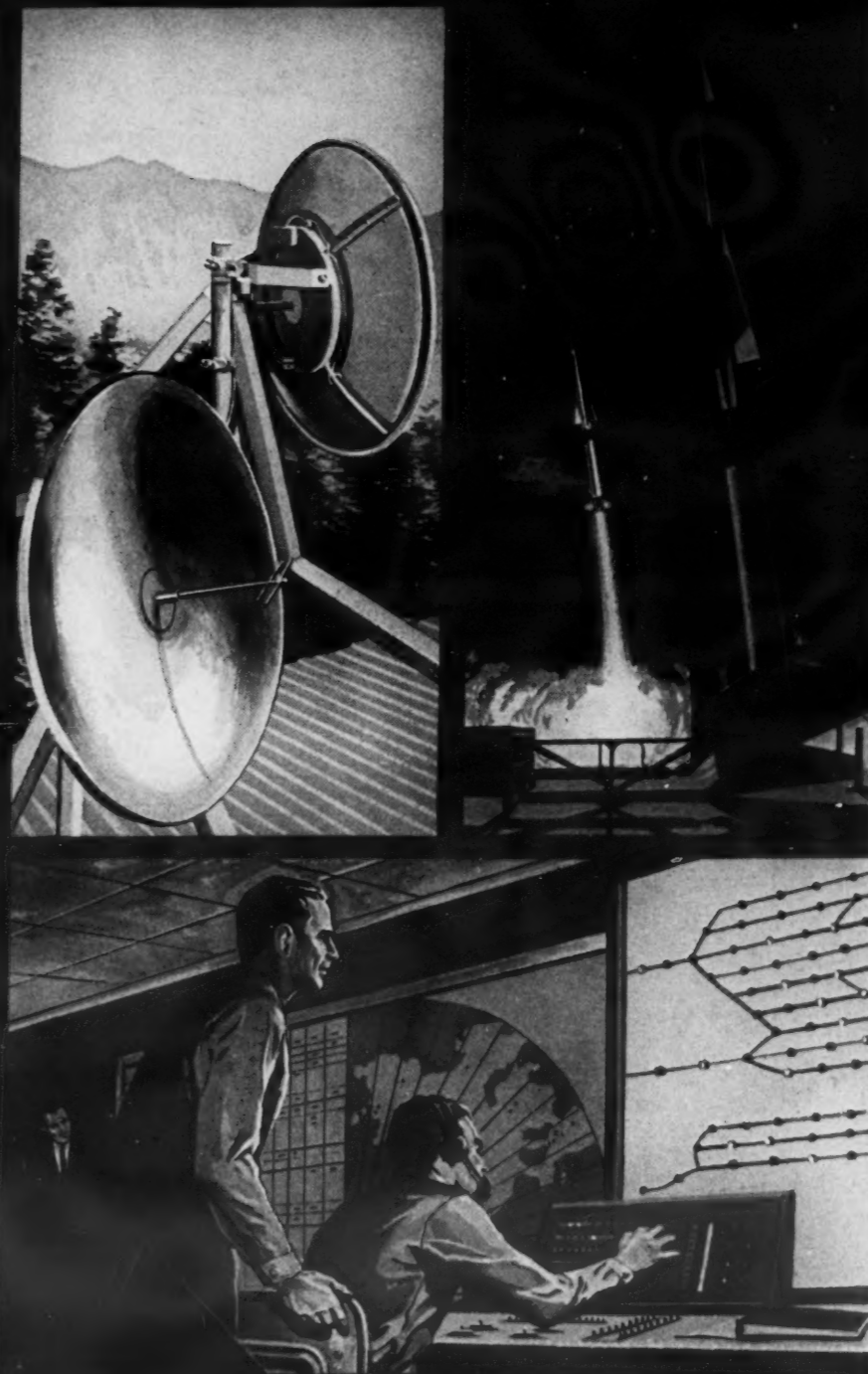
(Continued on page 61)

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CONSOLIDATED DIESEL ELECTRIC CORPORATION




Condec Units Provide Continuity of Precise Power in a Single Package ... for any application ... for protection against

Power Outages - Voltage Instability - Frequency Instability

If a failure of your normal source of electrical power for a few seconds simply means an inconvenience, such as the lights going out or machinery pausing and then resuming its normal pace, you have no need for an Uninterrupted Power Supply.

On the other hand, if loss of power for a few seconds or even microseconds, spells calamity, as it does for:

- 
- High-speed communications networks where loss of power means lost intelligence.
 - Microwave repeater systems where loss of power at a single station disrupts an entire system.
 - Air traffic control systems directing high-speed aircraft in dense traffic patterns.
 - Nuclear reactor control systems.
 - Missile firing and tracking operations.
 - Processing industries such as film processing where coating materials may congeal in a few seconds without power.
 - Hazardous areas where, without ventilation, dust concentration may reach explosive levels in a few seconds.
 - Electronic data processing systems where lost microseconds mean lost digits.

a Condec Uninterrupted Power Supply may be your cheapest form of insurance.

In terms of dollars saved, lives preserved or production capacity kept operative, it could pay for itself in a single power failure.

WHAT IT IS

A Condec Uninterrupted Power Supply is a complete packaged system for assuring absolute continuity of electrical power.

While parts of an Uninterrupted Power Supply system bear a physical resemblance to the diesel generator sets commonly used for standby emergency power, there is no similarity in performance.

An Uninterrupted Power Supply is always "on the line." When a normal supply of power is disturbed, UPS continues a flow of power with no down time. Ordinary standby diesel generator sets wait until power fails, then start and assume the load when up to full power — a matter of some 10 or 12 seconds.

WHEN TO BUY AN UNINTERRUPTED POWER SUPPLY

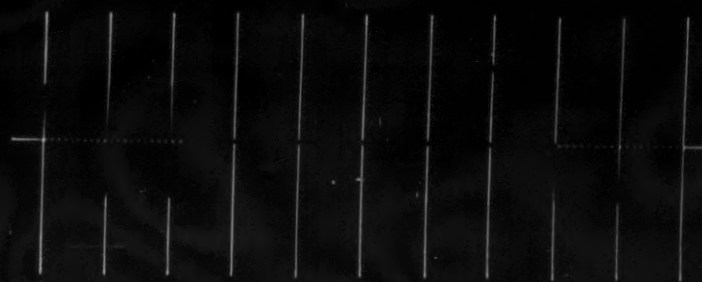
Buy it only as insurance for uses where power loss for any length of time can be costly or dangerous.

Because an Uninterrupted Power Supply unit must work every time, it is an intricate piece of machinery. All components are matched and balanced, and the unit itself designed for utmost reliability under any fault condition. This Condec design has been preceded by four years of test and development of the UPS and twenty years of generator set design and manufacture.

There are Condec UPS units in all standard sizes now in operation in user locations.

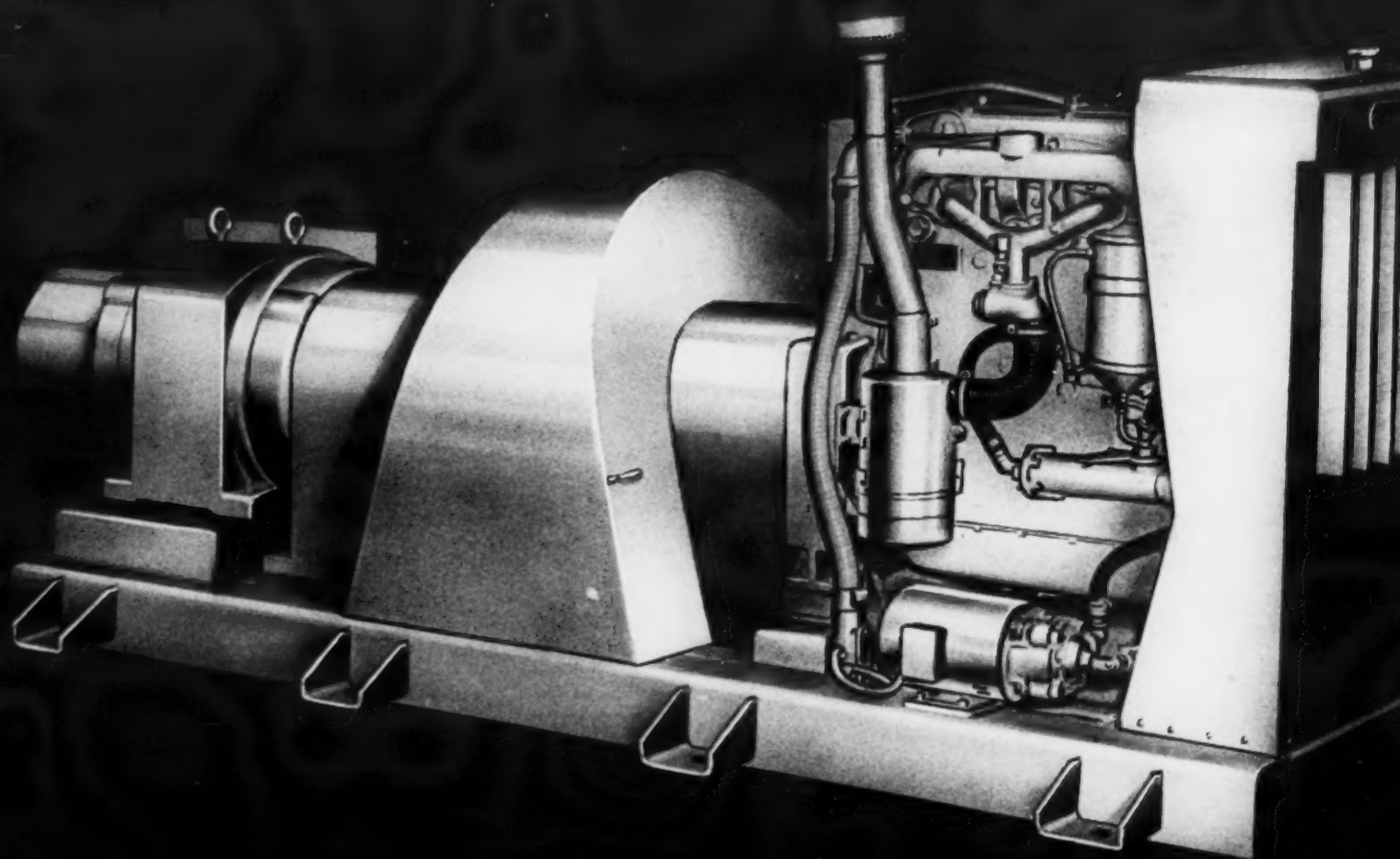
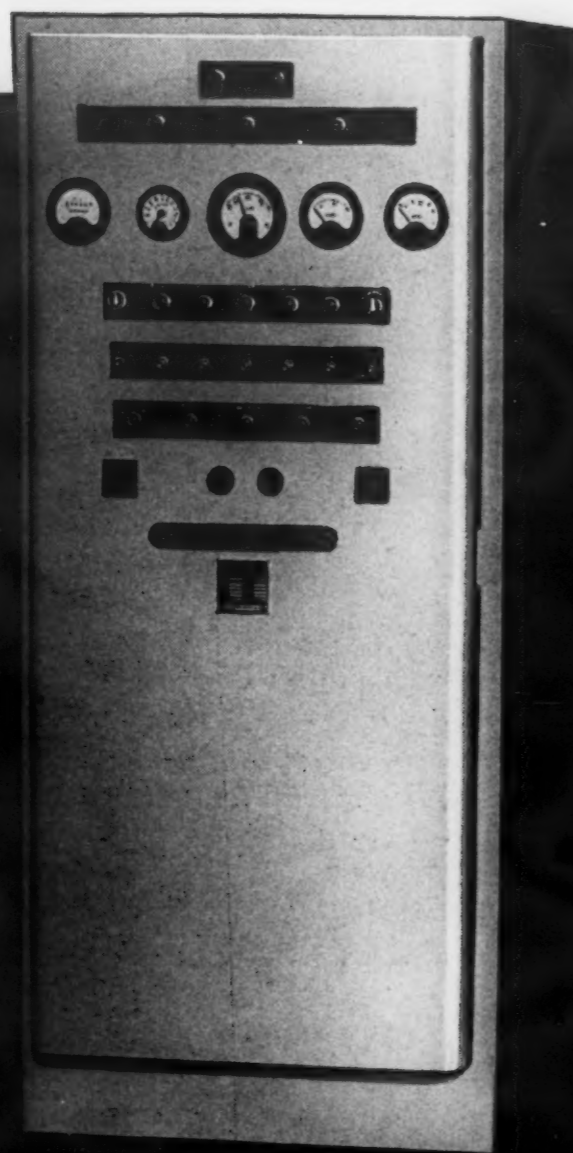
We urge you insist on proved performance for this important apparatus when you consider an UPS unit. We recommend you include a clause in your order requiring test data be furnished from a previous unit of similar size and rating.

UNINTERRUPTED POWER SUPPLY



MODEL UPS

... reliable, precise



POWER EQUIPMENT DIVISION

se **power without interruption where normal commercial power is stable and satisfactory**

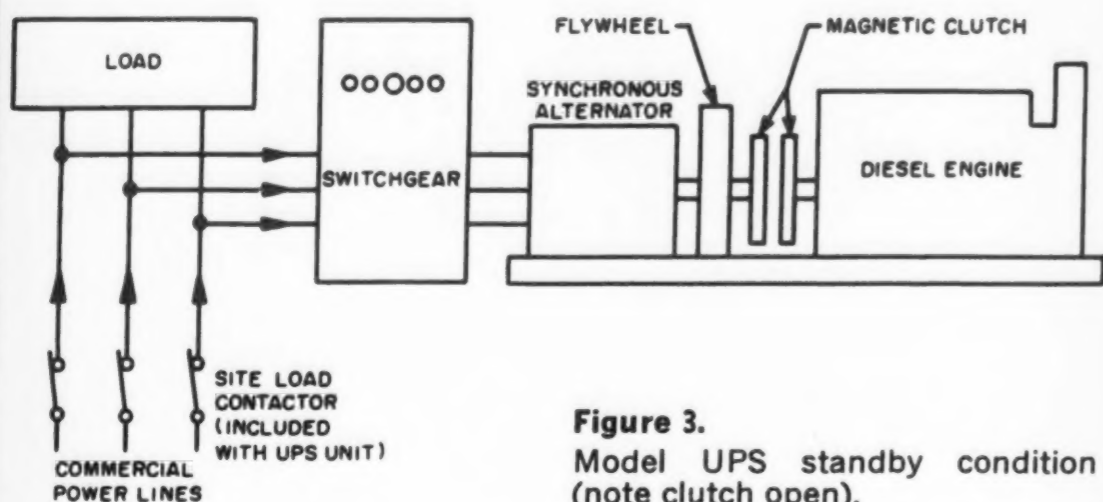


Figure 3.
Model UPS standby condition
(note clutch open).

The Uninterrupted Power Supply consists of a synchronous alternator and flywheel connected to a diesel engine through a magnetic clutch. The synchronous alternator normally operates on commercial power and rotates the flywheel. Power is fed to the load and to the unit through the site load contactor.

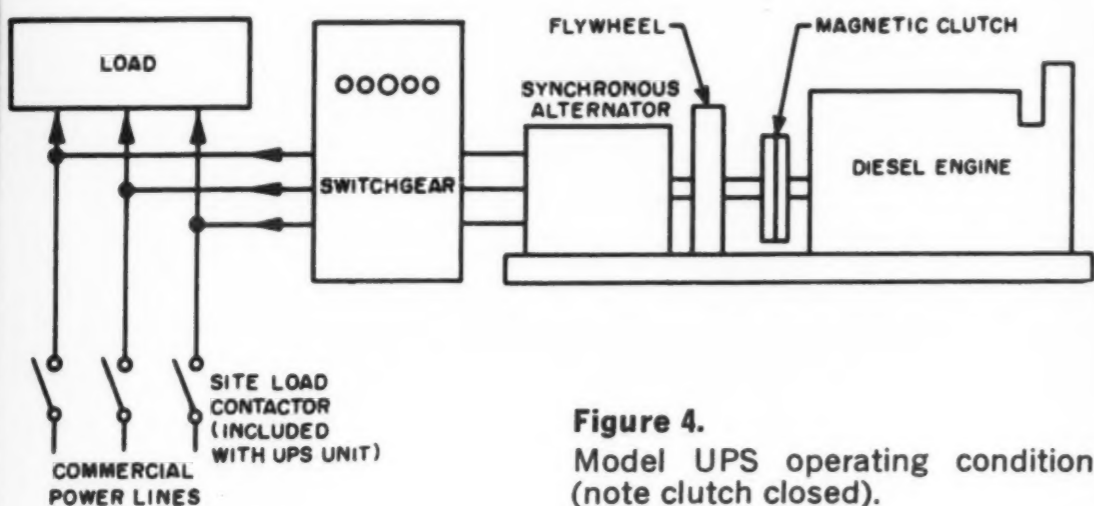


Figure 4.
Model UPS operating condition
(note clutch closed).

If power fails or falls below established minimums, a reverse power relay opens the site load contactor and energizes the magnetic clutch. Inertia in the rotating flywheel starts the diesel engine and also carries the load on the alternator during the transition period. The diesel engine then assumes the load and the UPS continues to produce power. During diesel operation, commercial power is constantly checked for quality. Once normal commercial power is again available, UPS automatically varies the speed of the diesel engine to synchronize its output with the commercial power. When synchronization is achieved, the load is shifted back to the commercial line, and UPS returns to its standby condition.



Specifications subject to change without notice

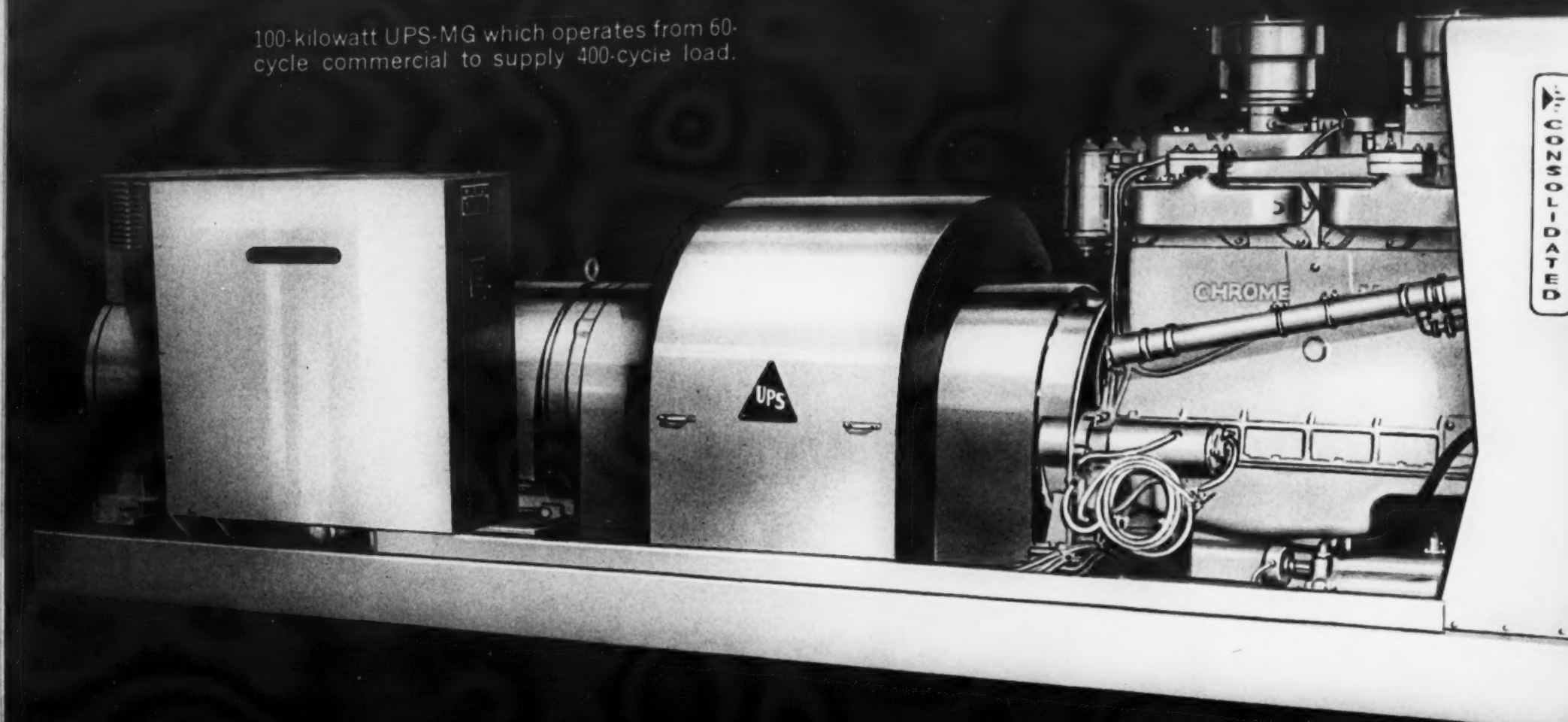
CONSOLIDATED DIESEL ELECTRIC CORPORATION



UPS-MG

... uninterrupted

100-kilowatt UPS-MG which operates from 60-cycle commercial to supply 400-cycle load.



Operating features

- 5 to 200 kilowatt capacity
- full power without interruption to load on either open or short circuit in commercial power lines
- synchronous or induction motor drive
- maintains voltage regulation within 2 per cent; eliminates voltage regulators at load
- frequency stability $\pm \frac{1}{6}$ per cent
- frequency maintained within 3.5 per cent during transition
- isolates load from momentary fluctuations in commercial power voltage or frequency
- eliminates need for transformer or frequency changer where commercial power does not meet load requirements in either voltage or frequency
- minimum surges in frequency from no load to full load

- automatic restoration to motor drive upon return of commercial power
- complete packaged installation, including all switchgear
- completely unattended operation
- engine runs only when needed

Construction features

- diesel engine rated to deliver full power
- rotating components on heavy steel base — shock mounted
- liquid-cooled engine with pusher-type fan
- full range of safety controls and fault memory light
- heavy duty electro-magnetic clutch
- flywheel ultrasonically tested and dynamically and statically balanced
- free standing cabinet contains all necessary switchgear. (Wall-mounted cabinet on 5 and 10 kw. units)

POWER EQUIPMENT DIVISION

power source for applications where normal commercial power must also be corrected for voltage, phase or frequency

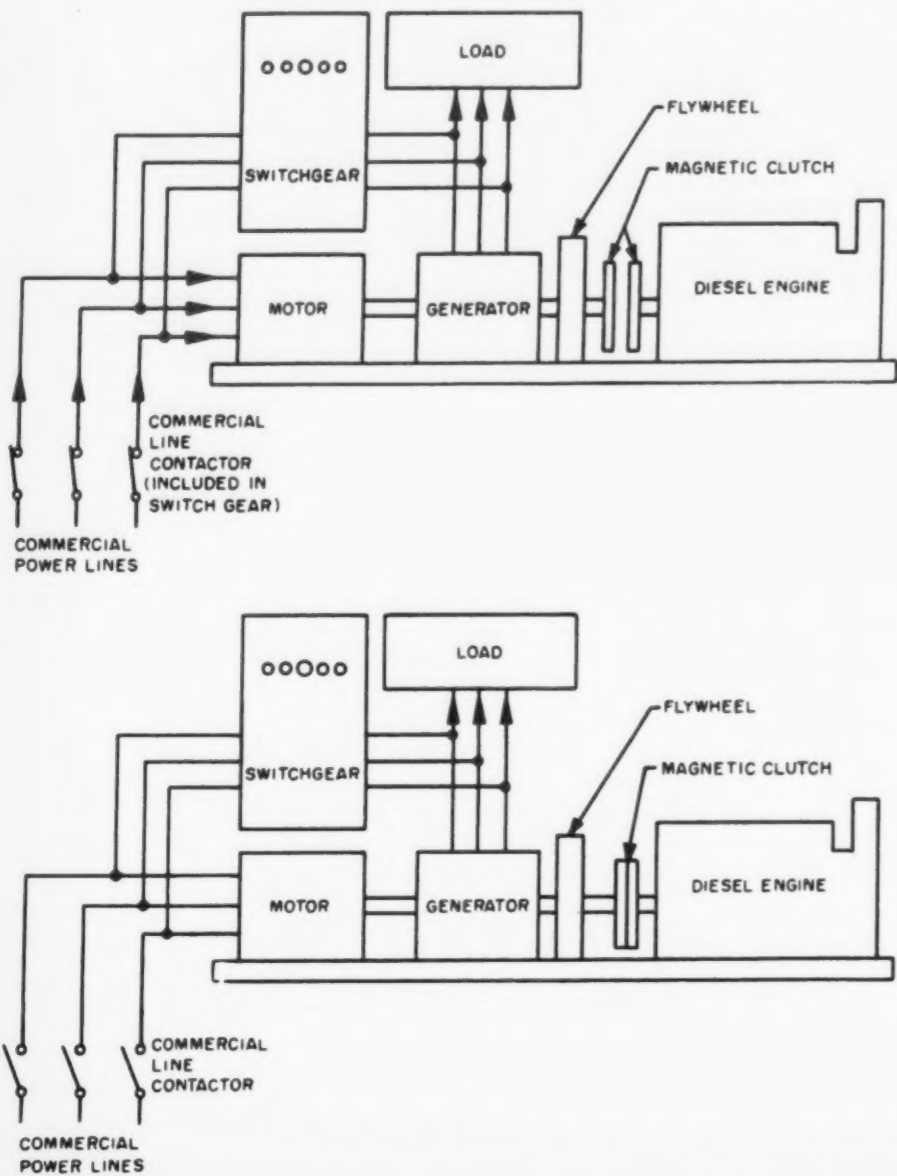
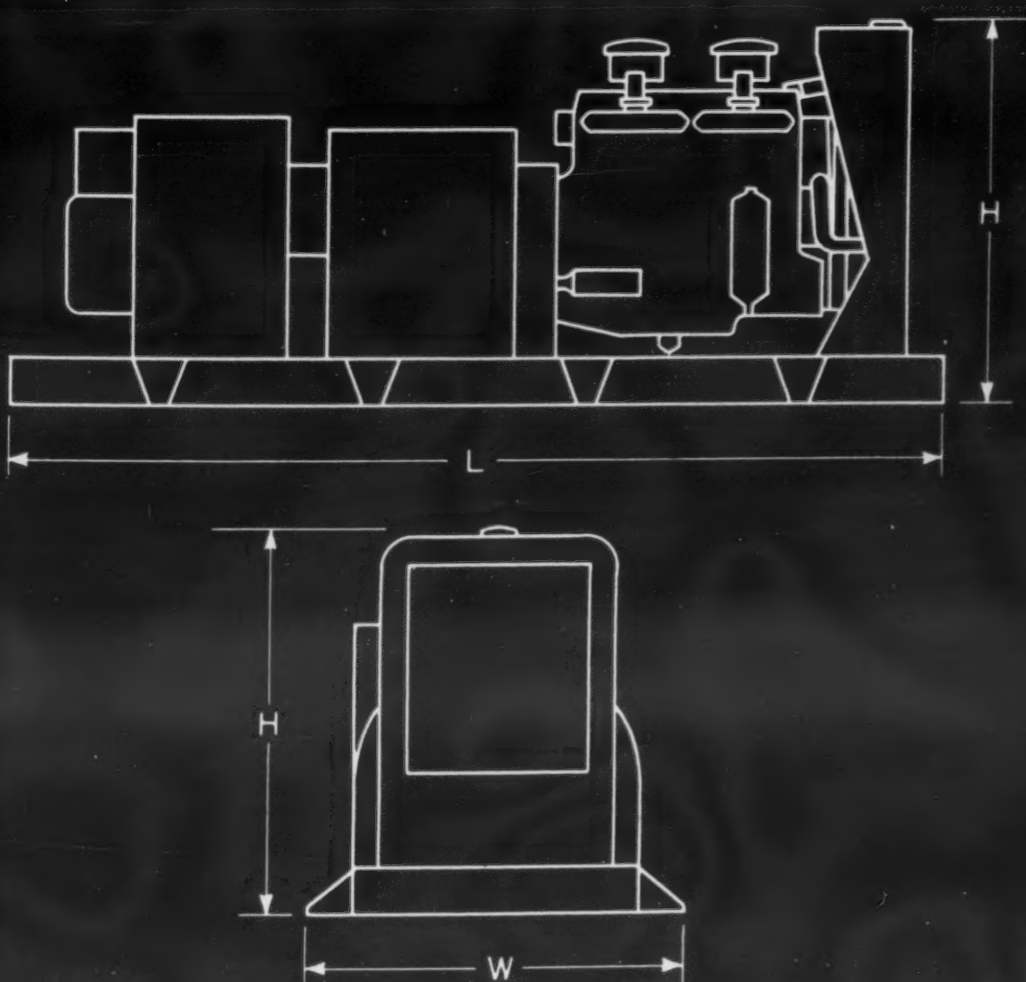


Figure 5.

The UPS-MG consists of either a synchronous or an induction motor driving a generator and a flywheel connected to a diesel engine through a magnetic clutch. The motor drive operates on commercial power of any standard voltage or frequency and rotates the flywheel and generator. Power is fed from the generator to the load in a selected standard frequency and voltage.

Figure 6.

If power fails or falls below established minimums, sensing relays open the commercial line contactor and energize the magnetic clutch. Inertia of the flywheel carries the generator load and cranks the engine with a minimum drop in frequency during the transition. After the diesel engine comes up to speed, it assumes the load and the UPS-MG continues to produce power to meet the load requirements. During diesel operation, commercial power is constantly monitored for quality. When commercial power returns to the correct voltage and frequency, the UPS-MG is automatically returned to the normal operating condition; that is, the commercial line contactor closes and the engine shuts down and goes on standby condition. The electric motor continuously drives the generator and the flywheel as shown in Figure 5



CONSOLIDATED DIESEL ELECTRIC CORPORATION



UPS IN ACTION

Frequency curve as 100-kw UPS unit responds to failure of commercial power. Curves for both UPS and UPS-MG models are similar.

Voltage and current response of UPS-MG type as generator drive shifts from motor to diesel engine in response to failure of power, either through shorting or opening of commercial feeder.

Voltage to 105-kw load protected by 100-kw UPS model as commercial power fails through opening of feeder circuit.

Voltage to 105-kw load protected by 100-kw UPS model as commercial power fails through shorting of feeder circuit.

POWER EQUIPMENT DIVISION

CONSOLIDATED DIESEL ELECTRIC CORPORATION

880 CANAL STREET, STAMFORD, CONNECTICUT • VAN NUYS, CALIFORNIA



Printed in U.S.A.

FIVE FIRMS have formed the Missile Facility Activation and Maintenance task group to build missile launch facilities. The companies which will build underground facilities for operational Atlas, Titan and Minuteman intercontinental ballistic missiles are the Del E. Webb Corp. (Phoenix), The Hallicrafter Co. (Chicago), Borg-Warner Corp. (Chicago), Newberry Electric Corp. (Los Angeles) and The Scott Co. of Northern California. The task group presently is submitting proposals for a number of missile launch complexes strategically located throughout the country.

CHICAGO'S SHARE OF MILITARY ELECTRONICS WORK has been decreasing while government expenditures in this field have been rising, according to Robert F. Halligan, president of The Hallicrafters Co. To restore a greater percentage of the nation's military electronics dollar to the Chicago area, Mr. Halligan calls for a concerted program by industry, political representatives, universities and the press. Halligan cited the 1960 Department of Commerce estimates which show the Chicago metropolitan area in sixth place in military electronics shipments, accounting for 2.7 percent of the total government electronics business of five to six billion dollars per year. The report shows the New York area leading the nation with 15.33 percent of the military electronics business, followed by Los Angeles, Philadelphia, Boston and Baltimore.

B-70 CONTRACTS are being reduced and, in some instances, cancelled as the result of President Kennedy's decision to redirect the Mach 3 B-70 bomber from a weapons system program to a technical development program. According to a Pentagon release, the Air Force is reducing the prime contract held by North American Aviation, and the subcontracts held by International Business Machines, Hamilton Standard Division of United Aircraft, Sundstrand Aviation and General Electric. Subcontractors whose work will be terminated are Convair, Lockheed, Beech Aircraft, Westinghouse and Motorola.

EIA MICROWAVE DATA SERVICE will supply microwave equipment manufacturers, user organizations and others with technical information essential in the design, installation, and operation of private microwave communication systems, the Electronic Industries Association has announced. Begun last month, this information service will utilize a standard form, developed by EIA with Federal Communications Commission cooperation, for compilation of all necessary technical data. This data will be submitted to the FCC as an attachment to private microwave license applications and photocopies of these forms are to be distributed weekly to subscribers to the information service.

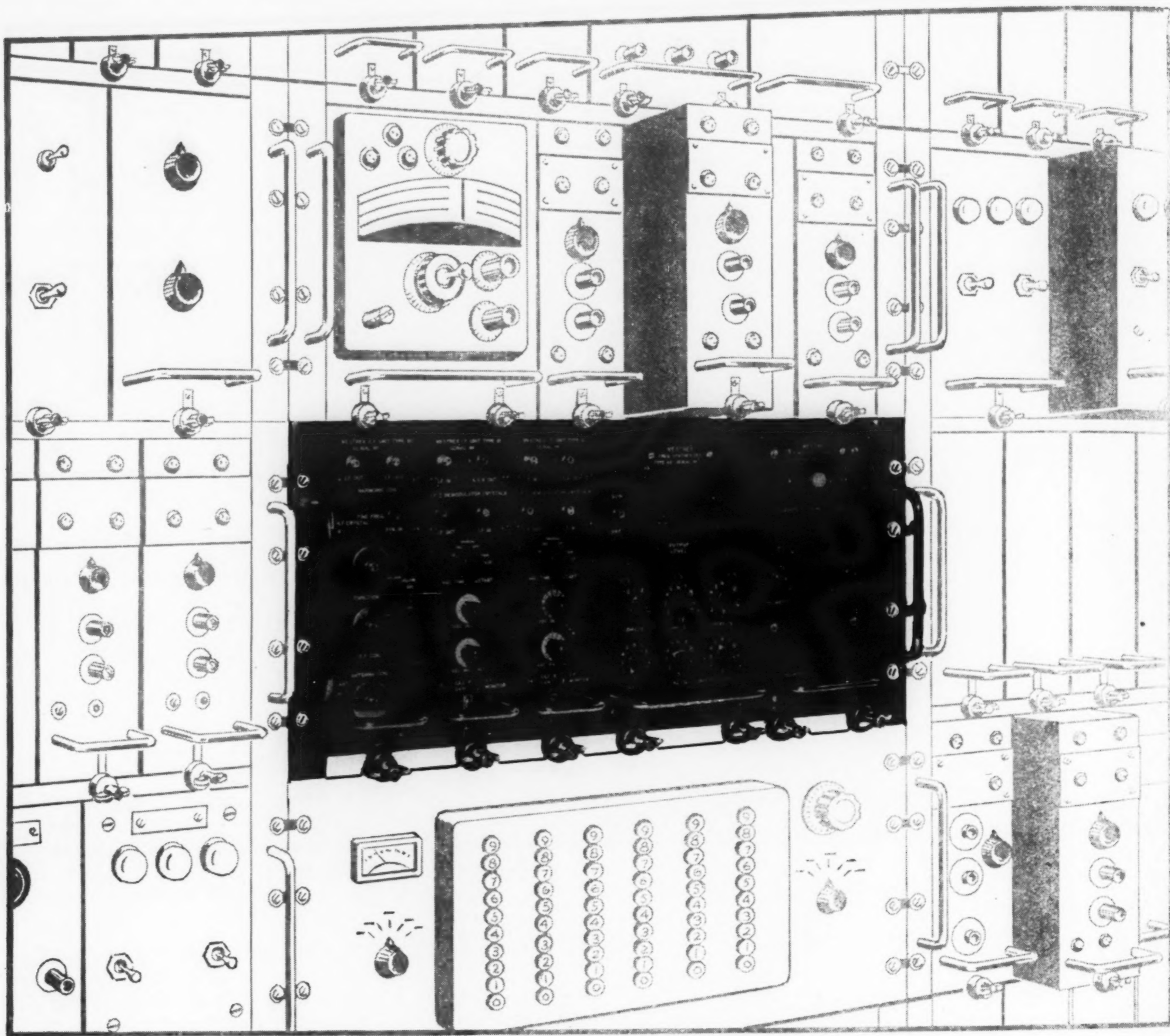
BOYCOTT OF FOREIGN ELECTRONICS COMPONENTS has been postponed through the efforts of Secretary of Commerce Luther H. Hodges who announced in March that a Chicago labor union would not begin its boycott for 90 days. Members of Chicago Local 1031, International Brotherhood of Electrical Workers had said they would refuse to handle foreign-made television-radio parts after May 1, contending that imports from low-wage areas are hurting U. S. industry and costing the jobs of many workers. Secretary Hodges said that the delay in the boycott would give the Commerce Dept. an opportunity to study further the situation and offer some solution.

ELECTRICAL EQUIPMENT PRODUCERS can expect increased future earnings, despite the government's successful prosecution of charges of price fixing against them, The Value Line Investment Survey says. Published and copyrighted by Arnold Bernhard & Co., Inc., this weekly booklet states that those electrical companies involved in the price rigging hearings have suffered a loss of prestige, but this "can probably be regained with diligent effort over a period of time." The survey continues, "If demand revives in the second half of 1961, as we currently expect, marked gains in earnings appear probable."

HOFFMAN ELECTRONICS CORP. is discontinuing its television and stereo manufacturing work and will use those facilities for the company's expanded operations in the military, semiconductor and industrial products fields where "there is a greater and more profitable future," according to H. Leslie Hoffman, company president. The company is retiring from the TV and stereo field "because we find that we cannot build traditional Hoffman quality into those products to sell at the prices now prevailing and still obtain a proper profit on our stockholder's investment in that activity," he said.

INDUSTRIAL ELECTRONICS OF OMAHA, recently established as a division of Railroad Electronics Laboratories, is building a standards laboratory to increase accuracy in installing and servicing electronic and electronic-mechanical equipments and instrumentation devices. Located in Omaha, Neb., the firm does work in the following fields: closed circuit television, meter repair and calibration, communication and supervisory control systems, industrial telemetering and ultrasonic equipment.

(Continued on page 63)



New HF SSB Receiver heart of a whole new "state of the art"

New flexibility. Building block modules make the Westrex 600 receiving system the most versatile communications receiver. The RF, IF, AFC, synthesizer, test and power supply modules can be arranged in any manner dictated by user requirements. As an example, a typical 4-voice channel SSB circuit can be established using one RF and four IF modules. As many RF channels as required can be accommodated using fixed frequency or continuously tunable RF modules. Operation can be either "local" or "remote."

New high performance. Significant features are:

- Extremely low third-order distortion (85-90 db) is made possible by a breakthrough in receiver front-end design.
- The sensitivity is very high. Image and IF

spurious rejection is excellent. The AGC is extremely flat over a range of 130 db.

- The SSB filters have exceptionally high performance with very low pass-band phase distortion and very steep selectivity skirts.
- Cast aluminum housings are used for the RF, IF, and synthesizer modules, keeping radiation to a fraction of common receiver values.

Learn more about this significant receiver development. Write or phone today.

Westrex Corporation

A DIVISION OF LITTON INDUSTRIES
Communications Equipment Department, Section 163
540 W. 58th St., New York 19, N. Y. 1625 I St., N.W., Wash. 6, D. C.



Westrex products being exhibited at AFCEA Show, Booths 61-62-63, Sheraton-Park Hotel.

TWO DATA SERVICES TO AID DEFENSE CONTRACTORS were announced recently by Daniel M. Sullivan, president of Frost and Sullivan, Inc. New York City. The first of these services, The Defense Sales Director, will supply bi-weekly information to subscribers on contracts awarded by government agencies to prime contractors, and from significant prime contractors to subcontractors. The second service, Defense Market Measures, is a statistical and analytical quarterly review of the defense industry. Here, contract awards are broken down by categories of defense products, and by prime contractors. The bi-weekly service costs \$250 per year for complete information on 25 defense system product categories, and \$10 per year for each additional category. The quarterly review is \$1200 per year for either the product series or the company series; \$2000 per year for both.

HUGHES AIRCRAFT CO. is making available its instrument calibration laboratory to private industry. The facility previously was reserved for use exclusively on Air Force equipment. The company was encouraged to take the step because of the increasingly stringent standards of accuracy being imposed on manufacturers by the demands of the space age, it is said.

INCREASED MILITARY REQUIREMENTS FOR RELIABILITY of electronic parts will mean greater costs to producers, but this rise may be offset by increased yield and greater reliability of equipment, according to Paul S. Darnell, Director of Military Reliability Engineering at Bell Telephone Laboratories. Mr. Darnell gave this opinion at the Electronic Industries Association recent meeting.

—GENERAL—

ALLOCATION OF TV CHANNEL FOR UNITED NATIONS' USE was proposed by David Sarnoff, chairman of the board of Radio Corporation of America, in an address delivered at the University of Detroit last month. Mr. Sarnoff believes that the United States should allocate one channel in the first television satellite to the United Nations so that "freedom might follow in the wake of television." Such a channel could help teach Africans about the purposes of the United Nations, he added.

RUSSIAN MAN IN SPACE circled the globe in an orbit ranging from 109 to 188 miles above the earth, according to Soviet reports, and traveled at a speed above 17,000 miles an hour, April 12. The Soviet astronaut, Major Yuri Gagarin, made the first space journey in 108 minutes.

LABOR-MANAGEMENT REPORTING AND DISCLOSURE ACT requires that employers disclose certain financial transactions and arrangements made with labor organizations, union officials, employees, labor relations consultants, or other persons. The Labor Dept. has prepared a Guide to Employer Reporting which explains under what circumstances an employer must file a report listing financial transactions. Copies of this booklet may be obtained by writing to John L. Holcombe, Commissioner, Bureau of Labor-Management Reports, Labor Dept., Washington 25, D. C.

INTERNATIONAL FESTIVAL OF TELEVISION ARTS AND SCIENCES is being held in Montreux, Lake of Geneva, Switzerland, May 15-27. As a highlight of the Festival, the International Telecommunications Union has organized an International Television Symposium for May 17-20 which will bring together technical experts from throughout the world to review the latest developments in all phases of the television art. Other events during the Festival include a trade fair and a television program contest. The trade fair will bring together technical equipments from all parts of the world.

FIFTH GLOBECOM SYMPOSIUM will have "Communications on a Global Scope" as the theme of the May 22-24 meeting at the Hotel Sherman in Chicago. Sponsored by the American Institute of Electrical Engineers and the Institute of Radio Engineers' Professional Group on Communications Systems, the symposium will present eighteen sessions of technical papers, covering all phases of the communications art.

CALENDAR OF EVENTS:

MAY 19-JUNE 4: British Trade Fair, Sokolniki Park, Moscow, Russia.

MAY 20: Armed Forces Day Military-Amateur Hamfest.

MAY 22-24: National Telemetering Conference, sponsored by American Institute of Electrical Engineers, American Rocket Society, Institute of Aero-Space Sciences, Institute of Radio Engineers and Instrument Society of America, Sheraton Towers Hotel, Chicago, Ill.

MAY 22-26: National Conference of the Society of Photographic Scientists and Engineers, Arlington Hotel, Binghamton, N. Y.

MAY 31-JUNE 2: Frequency Control Symposium, sponsored by the Solid State and Frequency Control Division of the U. S. Army Signal Research and Development Laboratory, Shelburne Hotel, Atlantic City, N. J.

JUNE 6-8: Armed Forces Communications and Electronics Association Convention, Sheraton-Park and Shoreham Hotels, Washington, D. C. DON'T MISS IT.



The pilot is inside, flying over enemy lines.

The SD-1 Surveillance Drone flies remotely controlled tactical surveillance missions without risking manned aircraft or pilot. It is extremely mobile, simple to use and maintain, and can be readily adapted to carry TV or

film cameras, infrared, radiation detection or radar reconnaissance equipment. The SD-1 is the Army's only operational surveillance drone. Northrop's Radioplane Division developed and produces it.



RADIOPLANE
A DIVISION OF
NORTHROP

Defense Industry as a Business

(Continued from page 25)

—to \$169 million, while the allotment for aviation was doubled to \$4.8 billion.

Getting out of the airplane business meant we would have to give up as unusable some facilities which could not be converted. It also meant that we missed some of the aviation business which by 1954 had doubled again to \$8.3 billion.

But now look what has happened. Government spending on missiles and all missile equipment has risen nearly fifty times to \$8 billion a year, while aviation has declined to \$6 billion. And in the next three years, of course, missile spending is expected to take up an increasing part of the budget for weapons and hardware.

As part of the transition from planemaker to missile-maker, we closed a plant. What was the result? This past year, with *two million square feet* less floor space, we have increased our volume by more than \$100 million.

Develop New Capabilities

To implement our basic decision to channel our energies into the missile, as well as electronic and nuclear fields, we had to develop new sets of capabilities and talents. We also spent a good deal of our stockholders' money. Of \$67 million in capital expenditures in the last five years, \$45 million went into the building of new plants at Denver, Colorado, and Orlando, Florida. Without these plants, we could not have accomplished this conversion. They employ 22,000 people, over half our work force, and they are engaged in at least five major missile programs—Titan, Pershing, Lacrosse, and Bullpup—and our Missile Master, an electronics system developed by Martin to evaluate data on friendly and enemy aircraft and to direct the fire of antiaircraft batteries.

I said before that the defense contractor can control his own destiny to a reasonable degree by the decisions he makes in anticipating the needs of the nation and its agencies and by the study he gives those needs.

The Martin Company has been in the nuclear business since 1954, and we continue to study and grow in the business. Within a year, Martin will deliver the first economically competitive nuclear plant. Of course, the reason that this nuclear plant is competitively priced is that it is going to McMurdo Sound, Antarctica. But we are working on nuclear plants closer to home that may be priced within the range of conventional power. We also have studies going in several other areas of nuclear physics. This year, for example, we have a detailed preliminary design for a nuclear propulsion system. Some day, we feel there will be a considerable need for nuclear-powered rockets. When that day comes, we will be ready to do such work.

Last November, the National Aeronautics and Space Administration awarded to Martin and two other companies in the defense business—Convair Astronautics and the General Electric Missile and Space Vehicle Department—three separate study contracts on a new advanced space project called Apollo. Each of the contracts is small—\$250,000 for six months of study. But Project Apollo is virtually sure to be a significant part of NASA's space program of the next decade which will probably account for expenditures of somewhere between \$12 and \$15 billion during this decade. Martin would not even be included in this initial Apollo study if we had not started working into the space field 14 years ago and if, in recent years, we had not assigned some 400 engineers

to devote full time to research and design studies bearing directly on space operations.

Talent in Depth

I want to make another distinction here between a company that is devoting itself to the defense business and a company that simply happens to do some defense work as a part of its general product mix, perhaps on one or two contracts. Defense companies may study the Government's requirements and anticipate them, but studies do them little good unless they also have the capability of delivering, both in terms of facilities and in terms of talents. At The Martin Company, for example, we have geared ourselves to an over-all planning program capability. This means that we do not wait until the military decides it wants a specific kind of weapon, or a particular system. We want to come in at the stage when the military has a problem and is seeking its solution. The well-grounded defense contractor must be prepared to help on the problem level, then to take the project all the way from problem to actual hardware.

The experienced defense contractor, in order to assure himself of the capability of delivery, must have a wide variety of talents to satisfy the advanced and complex requirements of the missile age. Like most defense contractors, we have quite a large R & D program at The Martin Company. In developing these talents, of course, we think we are building ourselves and our capabilities so that we can tackle any problem posed by the military. Incidentally, of The Martin Company's 7,500 engineers, 40% are in electronics. I would like to take one moment to mention some of the areas in which we have specialized groups working, because I think it illustrates how a defense contractor must have technological capability in depth in order to work in the current, fast-moving fields of weapons technology and space exploration.

Martin has always had particular capabilities in materials and in fabricating alloys, for example, dating from the days in which we worked with the aluminum companies to create the high strength alloys for 17ST and 24ST aluminum airplane "skins." Last year, we spent \$500,000 simply on developing new materials and material processes. As an illustration of what this particular capability can mean, Martin engineers first developed the technique of "honeycombing" for strength, and The Martin Company holds the basic patents on these processes. The first practical use of this honeycomb was in the "Gorgon" missile we built as a target drone for the Navy. The Gorgon had honeycombed wings. Now, honeycomb is widely used in a variety of applications.

New Technology Requires New Talents

But most of our technological talents today are new, in fields which we have entered since we decided to concentrate on the missile, nuclear and electronics business, and to stop manufacturing airplanes.

We have, for example, 150 mathematicians on our staff working on astronautics, the study of motion in space, orbital mechanics, and space trajectory.

We have several teams studying bionics, life sciences and how man gets along in an unfamiliar environment. If we are going into space—and we have certainly dedicated ourselves to that proposition—then we must also know how to deal with men in space, how they can control their spacecraft, what we have to build to insure that they can work properly and efficiently once they arrive in space.

One of our most stimulating groups does not work on specific developmental or production problems at all. This is the Research Institute for Advanced Studies, RIAS, a division of The Martin Company which devotes itself exclusively to basic research and which has nothing to do with so-called applied research. We formed RIAS because we felt this country had, for a long time, imported its basic scientific ideas from abroad and then adapted them to excellent production techniques. We wanted to establish a climate for basic research in the United States. RIAS has no program schedules as we know them in industry generally; all its research is in such fundamental disciplines as mathematics, physics, biology, chemistry and metallurgy. At the RIAS Mathematics Center, we have the largest group of mathematicians in the free world devoted to the study of non-linear differential equations. In the RIAS Biosciences Group, biologists are engaged in an intensive study of photosynthesis, the life-sustaining process by which plants produce food—which has tremendous potentialities. When we started RIAS, contracts from public agencies covered only 5% of its annual costs. Now, they cover more than 40%. We feel that a government contractor in a scientific field has an obligation to pursue basic research in that field, and we consider RIAS one of our most exciting ventures.

The Question of Diversification

With a variety of talented technical groups, the defense contractor has, of course, added a considerable factor of stability to his business. Our own spectrum of talents at Martin has led us into a number of programs, sponsored by a number of government agencies, so that the phasing out or cancellation of any single program will not throw us too much off our stride. And as time goes on and we become more and more deeply involved through agencies like NASA in the government's space activities, this diversification will be increasingly significant.

As far as diversification goes, the decision-making that it poses centers as much on what *not* to do as on what *to* do. We have seen some of our competitors in the defense business become enthusiastic about diversification and charge off in a number of directions. Some of the large prime contractors who have seen their airplane business diminish have begun manufacturing tobacco-handling equipment, kitchen sinks, mobile homes, air conditioners, and popcorn machines. In one instance, back in the late forties, we had developed a process called Martin Marvinol, a polyvinyl resin with a variety of uses, which could be put in bags and shipped dry instead of in the usual "sludge" form. Our product was excellent, but we did not have enough experience in marketing a new field.

Every day we resist plans to diversify into fields in which we are very capable indeed, but which do not fit our over-all concepts. We could, for example, have contributed even more than we are contributing to the building of Titan missile sites. Building these sites is a complex matter and one in which we have some knowledge, since we build the Titan; it differs from ordinary construction. But we deliberately did not choose to get into the construction business. We are a defense contractor and recognize the difference. I know that many companies tell of their efforts to cut down on military work and increase commercial business. We have no such intention—at least in the near future. We are specialists in defense. To paraphrase an old automotive slogan, "when better defense weaponry is built, Martin intends to build it."

We do, of course, diversify into new products, gen-

erally, so new that they do not compete with established commercial products. For example, we are building nuclear reactors and "packaged" nuclear plants, and we are working on satellites that may greatly affect civilian communications.

Most defense contractors have developed acquisition programs in which they look for companies whose abilities complement their own. Martin, as you probably know, is no exception to this policy. Our feeling is that such companies should have a technical flavor—some particular ability that can be combined with the defense-oriented abilities we have built at Martin. You probably know that we have purchased a substantial interest in General Precision Equipment Corporation and in Nuclear Corporation of America. We shall continue to consider companies whose technical abilities complement our own.

How Programs Breed Profits

I would like to make one point about profits because it is certainly no secret that the profit margins of defense contractors are considered by analysts to be a deficiency of the defense industry. It is certainly true that no defense contractor can make the high profit margins that characterize some aspects of commercial manufacturing, and possibly because of this there seems to be a particular bias against cost-plus-fixed-fee work.

Cost-plus-fixed-fee work does provide considerable incentive. The basis for profit is not the actual costs, but the *target* cost, so that the contractor is rewarded if he can pare his costs. And a defense contractor can certainly increase his total profits every year on cost-plus-fixed-fee work if the contractor's capabilities mean that he can increase his volume.

The basic reason for so much cost-plus-fixed-fee (CPFF) work in defense and space programs is the kind of technology we deal in now. We are in a race for technological supremacy, so that we can seldom arrive at a production model, the way we did with aircraft, then decide that *that* is the model that will do the job, freeze the design and turn it out in quantity. Technology moves so swiftly that by the time a missile is on the pad, there are already major modifications that can—and really *must*—be designed into subsequent models. Without volume production, CPFF is the most natural form of contract for both the government and its contractors.

Sometimes, however, we can and do get to profitable volume production, and it extends over a period of time much longer than we expected when we first designed the product. We began our missile work in 1946, with the Viking high-altitude rocket and the Matador missile. Today, 15 years later, a direct descendant of the Matador, the Mace, is still in production.

We have been working on the Titan ICBM for nearly five years. To date, all Titan's fired have been part of the development program, and this missile will become fully operational in its hardened sites this year. Already, however, metal is being cut on the Titan II, which is not only more powerful, but much more simple in its operation. With operational Titan I and II's still to be manufactured, coupled with the great potential the Titan has as a space booster, we now can foresee a life span for it even longer than that of the Matador.

Phasing Out

No weapon lasts forever. When the Government cancels a contract, it makes headlines. There are stories of plants closed, workers laid off, and a general atmosphere

(Continued on page 68)



To listen to a whisper 22.5 million miles away...required Motorola reliability

TRACKING PIONEER V

for 22,500,000 miles, on its way to solar orbit, was aided by Motorola's frontier capability in solid state microwave technology. Compact, ferrite UHF isolators were especially developed to boost tracking receiver performance in order to detect the last faint whisper of available signal strength at this history-making distance.

At ranges approaching this depth in space the conservation of only 0.1 db in signal can add over 200,000 miles of communication. The non-reciprocal properties of ferrite devices were utilized by Motorola to stabilize the gain of parametric amplifiers from changes in antenna impedance. In addition to its advanced solid state contribution, Motorola also was responsible for providing more than 100 cases of high-sensitivity communications equipment on this significant space probe project.

Military Electronics Division



MOTOROLA

*Qualified
technical personnel
are invited
to apply*

CHICAGO 51, Illinois
1450 North Cicero Avenue
SCOTTSDALE, Arizona
8201 East McDowell Road
RIVERSIDE, California
8330 Indiana Avenue

of traumatic shock, as if the contractor wakes up one morning and is suddenly hit over the head. I think this sense of trauma has contributed to the financial community's idea that the defense business is one of extreme risk, in which sudden death lurks constantly in the wires from Washington.

It doesn't have to be that way. In the first place, it shouldn't be that much of a shock. Let me give you an example.

The Martin Company has built seaplanes for many years. The last plane Martin ever designed was an advanced mine-laying seaplane called the P6M. The Navy had set up quite a large program for these planes.

We do our homework at The Martin Company, and we knew that the Navy had a number of other projects in mind of higher priority than mine-laying seaplanes. It had the missile-firing submarine, the Polaris program, which called for several billions of dollars. The Navy also wanted more nuclear ships and the modernization of its fleets. Furthermore, to make our P6M most effective would have required a network of expensive seaplane bases. It was evident that budget limitations were not going to permit the Navy all of its programs, and that, in view of all the other things that were going on, our seaplane had relatively low priority.

It therefore came to us as no surprise when, after several meetings, the Navy decided to terminate the P6M program. It did not throw us off our stride. We allocated other work in missiles to the plants that had been working on the P6M.

We feel this is what a defense contractor must do when he begins to see the end of a program. In the past, too many contractors have had a tendency to hang on to products that they knew were obsolete. We think the healthiest thing for the contractor to do is to accept the end of a program. In this way, a defense contractor is no different from a commercial manufacturer. When the commercial manufacturer finds his sales of a product falling off, he works on new models and new products.

The way for a defense contractor to handle the phase-out problem is simply to have a number of projects to work on, all in varying stages of development. If the defense contractor has planning ability and capabilities in a number of areas, if he knows how to look into the future and foresee his customer's needs, he will not have to cling to any one product or project.

At The Martin Company, we are working on many very small contracts, counted in thousands of dollars rather than the hundreds of millions that are involved in major projects. But some of these small contracts are future giant programs in an embryonic stage. We look to them to be our near future.

The Future of the Defense Business

It used to be, when you spoke of the "defense business," that you meant merely a handful of companies, or "the aircrafts." The situation is very different today. As I noted before, many of the companies that were "defense" companies are doing their best to get out of the business. At the same time, makers of a wide variety of products—from school furniture to light bulbs—are also diversifying into defense, so that the "defense" business is now a very amorphous one.

My point really is that the term "the aircrafts" is rapidly becoming meaningless. Perhaps even the term "defense business" is too limiting. The business we are in is certainly not aircraft, is not just defense, but is exploring and extending the frontiers of man's knowledge. We think we are building a company whose talents and resources will meet this challenge.

Challenge Facing the Navy-Industrial Team

(Continued from page 29)

force rather than in a train to the rear. She will be able to carry as much oil as the Navy's latest class of tanker, as much ammunition as our latest ammunition ship. The combat support ship AFS will combine the resupply capabilities of the present store ship (AF), a general stores issue ship (AKS), and an aviation supply ship (AVS).

Both the AOE and the AFS will have helicopter platforms. Helicopters will be able to fulfill immediate needs for supplies other than fuel of ships in a task force spread over a wide area.

We are getting into a completely new type of auxiliary with the oceanographic research ship *Agor*. There is one in the 1961 program and two in the 1962 program. These will be especially designed to give a better knowledge of ocean bottom currents and configuration, sound propagation under various conditions, and the effect of sea life and temperature upon sonar conditions. To do their best work these ships must be very stable. We want to enable them to remain as level as possible even while sitting still in the water. Active fin stabilization will help while the *Agor* is underway. Anti-rolling tanks will do the job when the ship is stopped. We are installing these anti-roll tanks on missile range ships as well as *Agor*s. On the *Agor* we expect to use a pair of fuel tanks.

Long Range Plans

One of the developments we have been pushing vigorously in the Bureau of Ships has been the application of hydrofoils to ocean going patrol ships. We have under construction a hydrofoil patrol craft which will provide us with invaluable data concerning the operation of such a ship in all kinds of sea states. We are going ahead with hydrofoils although many problems remain unsolved concerning them. We need to cut down hull and machinery weights, to strengthen foil structural members, to increase propulsion efficiency, and to gather more information on super cavitating foils. The foils for these ships will have to be made of very durable material. With water particles hitting these foils at speeds of 50 miles an hour or more it is impossible to keep any kind of paint or coating on them. Undoubtedly, corrosion damage to foils will plague us for some time. The hydrofoil research ship in the 1962 program will be from 150-200 feet in length and displace 250-300 tons. It will be a light weight rugged structure with light weight and efficient power plant and transmission. It must be able to withstand occasional buffeting by waves while traveling at very high speeds.

We are exploring other unusual means for increasing surface ships speeds, including ground effect machines. We call them hydroskimmers. Recently we ran a series of tests on one of these craft. The cushion is created by powerful fans. We tried one model having sides or curtains extending down into the water. We found that we got more lift by thus preventing some loss of air pressure, but the curtains cost us something by creating more drag. Theoretically these hydroskimmers become more effective as they become larger—they become faster, more maneuverable, and deliver more payload.

There are major problems involved in developing satisfactory ocean-going vessels using the ground effect principle, however. We are tackling these seriously, but it will be some time before this principle can be made practical.

In the sphere of "inner space," a term applied to the deep ocean, we are constructing at the Portsmouth Naval

Shipyard a deep diving submarine. The design of this submarine emphasizes small size, active and passive sonar, and instrumentation for acoustics and oceanographic research, as well as increased test depth. This ship will enable us to explore deep depth structures. Although the Navy already has increased test depths of submarines very considerably, experimental development with the deep diving submarine will undoubtedly enable us to take a major additional step.

Now that we have covered the more encouraging aspects of our operations, let me tell you of our most serious problems. A rising price spiral has been eating away at our shipbuilding efforts for some time.

In the later 1950's, mounting costs made themselves felt in an increasing number of ship cancellations and deferrals. We were losing valuable ground in our fight to replace aging Fleet units with modern ships. Recognizing a need for drastic action, we launched an all-out counter-offensive in 1958 under some of our aggressive, cost conscious senior officers group together in a Ships Cost Analysis Panel, called SCAP for short.

The conclusions reached by the SCAP panel provided us with a plan of attack by specifying areas where costs could and should be cut. Our economy efforts were meant to embrace the whole Bureau, its field activities, and as far as possible, its contractors.

One of the most important elements of SCAP has been the establishment of a senior officer constituted Change Review Board. I am sure that many of you realize that during the three to four-year construction cycle of a major ship many changes are proposed which, presumably, will improve the ship when it is finished. The Change Review Board evaluates each proposed change, approving only those changes that will increase significantly at reasonable cost the effectiveness of the ship.

The Change Review Board has diverted approximately \$45 million from proposed changes to more urgent projects since late 1959.

The Bureau of Ships initiated value engineering in the Defense Department in the early 1950's. Since 1954 cost reductions of \$37 million have been realized from a total investment in the value engineering program of \$1,700,000. The Bureau has applied value engineering across the board. I am talking about value engineering here in its broadest sense. This pertains not only to specific pieces of hardware, but value engineering of management, methods, procedures, plans, organization and every other element that contributes to our end product. In the Bureau this, of course, means the building, repair and conversion of ships.

The Ships Cost Analysis Panel examined our military specifications and found that they were absorbing millions of dollars annually in that they were unnecessarily restrictive and excluded commercial items that would give equivalent service. The military specifications often imposed burdens on Navy suppliers by a set of complicated references and cross-references. We have already eliminated 1650 specifications and have drastically revised many others.

We have held regular conferences with shipbuilders and electronics and machinery components manufacturers. They responded with scores of suggestions that have brought gratifying results. The varied experience of these industrial leaders has given us the benefit of the most progressive programs devised for industry.

Definite and valuable results came out of these meetings. For example, it had become the established practice for electronic manufacturers to supply major equipments like radars in several massive, individual cabinets. We

discussed the situation and decided to substitute sturdy light weight rack-and-panel construction of below decks equipment. In one radar installation a single standard size compartment houses and shields all the electronic circuiting formerly packaged in eight large individual enclosures. The new design gives us a 50 per cent reduction in packaging costs, a 15 per cent reduction in weight, a 25 per cent reduction in manufacturing costs, and a 50 per cent reduction in the number of interconnecting cables.

As a result of some of these measures we have instituted, we have reduced costs as I indicated earlier very substantially. In a recent ship award we called for commercial marine specifications as far as possible. According to our calculations, the low bid was 30 per cent or more than \$10 million below what it would have been under our former system. We think that the reorganization of planning operations in naval shipyards will reduce planning costs by over \$7 million per year. Of course, these are not one-shot savings. They will continue over the years.

Technical Challenges

In addition to the economic problems we have discussed, the Navy also has serious technical challenges to meet. One of these is to reduce the noise, space, and weight of ship machinery. Reducing machinery noise will increase detection immunity of submarines and will make the sonar systems of surface ships more effective. Reducing the size and weight of the machinery affects the size of the ship. For every pound of added weight and every cubic foot of machinery space there must be a proportional amount of weight and size added to the hull structure or less payload or fuel carried. Another problem related to the ship's mechanisms is that of electronics and electrical equipment. Each new piece of electronic equipment must be analyzed for its possible adverse effect on other equipments, as for instance in the case of radio interference.

Other challenges deal with the ships themselves. For example, as submarines dive to greater and greater depths their hulls and component parts are subjected to increasing stress and strain. Therefore, research is going on to develop stronger steels which will result in less fatigue. It is hoped that an HY-150 steel can be developed in place of the HY-80 which is now standard.

Because of the increasing operating depth and speed of submarines, anti-submarine warfare poses a challenge. Current research and development programs are concentrating on sonar development. The goal is to improve the range, classification, target handling, and information transfer of the detection devices.

Another preventive challenge is that of protecting ships and their component parts from the potential effects of shocks and blasts. With explosive power always increasing, the protective measures become increasingly important. Our personnel, too, must be protected from radiation and toxic chemicals, and an extensive research program is being carried on in this field.

Perhaps our greatest challenge is that of ship design. We must imagine what our needs will be 20 years from now, and then, this month, this year, design ships that will fulfill those far-off needs. In a sense, this is an impossible task, for the present speed of technological developments almost guarantees immediate obsolescence. We must, however, strive to design ships which have sufficient potential for modification. If we succeed in this it means throughout the years we can modernize our ships and so keep up with the times.



INTERNATIONAL COMMUNICATIONS

past and future

by RAdm. ELLERY STONE, USNR (Ret.)

Director, International Telephone & Telegraph Corp.

Group Vice President, ITT U. S. Defense Group

Chairman, American Cable & Radio Corp. and all subsidiaries

I STARTED as a California "ham" in 1909 and received my first commercial operator's ticket 50 years ago. A half-century in communications scares even me a little to think about it, but it has its compensations at that. Because one is privileged to see a great deal happen in that period of time—not only in the wonderful progress of the art itself but in the development of government policy toward it, both here and abroad, in the growth, and sometimes in the decline of companies engaged in communications and in the cementing of friendships with your colleagues. It has been very rewarding in the broadest sense of the word.

It wasn't engineering 50 years ago as one thinks of engineering today, but it was still sound because it was largely empirical or "cut and try"—and don't let anyone tell you the best modern engineering isn't empirical too, to a large degree. Otherwise, why do we currently make such a fetish of "reliability"? Those were the days when the De Forest audion, our first vacuum tube, invented only four years earlier, was in very short supply. None, in fact were to reach the Coast until a few years later, so the standard receiving detector was the carborundum or the electrolytic. This was before the more sophisticated silicon or galena crystal detec-

tors had come into use. What is interesting is that those earliest detectors, similar to the transistor, used a locally supplied potential so that you were dealing with more than the energy of the received signal. But there was no amplification beyond the detector stage. This was true with the commercial receivers of those days as well as those of the hams. That is why we had to squeeze the last drop out of the received signal; you couldn't just add a tube to compensate for low signal level. The Germans helped with their invention of litzendraht wire to reduce the high-frequency resistance of receiving tuners—hook-up wiring was silver-plated, the most elaborate ground systems were employed, even some antennas were made of silver or silver-plated wire.

"Soft" Tubes

When the first audions hit the market, long distance communication was revolutionized. Of course, the first ones were "soft" tubes and could only be used as detectors. But being soft, or low vacuum, they depended on a precise degree of ionization and plate potential. Too much plate potential or too low a vacuum, and a tube would go "blue" on you and you had to reduce voltage to overcome this locked-out condition. Of

course, the filament soon burned out as we struggled for distance. Even if you had the money, and most of us didn't, you frequently couldn't buy a tube because the production was so limited. So you resorted to a glass blower who repaired X-ray tubes for a living. Now it is well known that all oboe players and glass blowers are temperamental; something allegedly to do with the effect on the brain that the high back pressure, which they have to generate for optimum results, produces. So you never could get them to re-pump the repaired audion to the exact vacuum required. Being used to pumping X-ray tubes, they usually went beyond the desired softness so the repaired audion was rarely as sensitive as a new one.

While visiting a fellow ham one winter to try to establish some distance receiving records, we used to get up around four in the morning to see if we could "copy" the East Coast. It was very cold in this farm house. But after a few mornings, we noticed that as the radio shack gradually warmed up from the oil stove, the signals got better and better. We decided that our repaired audion was on the high side, and that the warmth of the oil stove as well as the filament was driving enough occluded gas from the elements within the tube

to lower the vacuum to the desired point. To secure a better control, we mounted our audion detector downward into a beaker of oil under which we had a spirit lamp whose flame we could regulate. Right on the nose! We were copying stations we never heard before. Then we reasoned, if we could deflect the electronic stream between the filament and grid and plate in some manner we might increase the slope of the curve to obtain the absolute maximum of efficiency. We took a U-shaped magnet out of a discarded magneto, built a little shelf around the oil beaker, and soon found the optimum position for maximum sensitivity. This is what I meant by squeezing out the last drop. I went to World War I as a communicator with my U magnet in my hip pocket and showed my sailors at NPL how to really lug in distance from the Canal Zone, Pearl Harbor, and Cavite. But by this time, 1917, we were really getting to be sissies with 2 and 3 stage tube amplifiers, so some of the old spirit was gone.

For the past 35 years we have covered up indifferent engineering just by adding another stage. Of course, the limit to this kind of approach is reached when the resulting tube noise lowers the signal-to-noise ratio. I remember discussing this back-sliding with Prof. Hahnemann of the Lorenz Company in Berlin in 1937, saying how much easier the modern engineer had it—just add a tube. But Hahnemann brightened up when he said, "Thank God for the Schr-r-roeder effect! Now they have to go back to work!" I think if he were alive today that he would be disturbed by the low noise properties of the transistor. What a temptation to add a stage!

U. S. International Communications

So much for a "ham's" reminiscences. Let us look at U.S. international communications as they existed 50 years ago. At that time, they were largely confined to the cable telegraph services of The Commercial Cable Company and The Western Union Telegraph Company, so far as Europe was concerned. To much of Latin America we had the cables of what is now All America Cables and Radio. Across the Pacific, we had the single cable of The Commercial-Pacific Cable Company—50% owned by the British cable companies of those days, 25% owned by the Great Northern Telegraph Company, (a Danish company) and 25% owned by the Mackay interests

which also owned The Commercial Cable Company and the Postal Telegraph Company. Two German cables and one French cable also served the United States. But as the result of World War I, the German cables were allocated as spoils of war—one to the British who towed it to Halifax, and the other to the French who took theirs to Long Island. Although Marconi had made his classic transoceanic radio experiments at the turn of the century, no transoceanic commercial radio circuits with the United States were in existence.

In 1910, Congress passed the Ship Act, as it was known, requiring all ships travelling 200 miles and carrying 50 persons or more to be equipped with radio and carry a licensed radio operator. I remember it was under this Act that I received my first commercial operator's license, the old "Certificate of Skill."

In 1912, because the *Titanic* disaster of the year before emphasized the need for a constant radio watch to be maintained on all radio equipped ships, the 1910 Act was amended to require two or more radio operators on all compulsorily equipped ships.

There was still no law in this country and, therefore, no regulating agency, for the assignment of frequencies other than the ship frequency of 500 kc. If you were a ham, you picked your own frequency and rode it out. If you had enough transmitting power, the next ham coming on the air stayed off your frequency. If he didn't, and lived within easy cycling distance as the British would say, you went over and pulled his aerial down and made rude remarks. In modern parlance, this is variously termed democracy, free enterprise, self-regulation or the law of the jungle. In those days, we just called it "picking your own frequency." The larger marine coastal stations selected frequencies which bore *some* relationship, however remote, to their transmitting power and the size of their antennas. If you wanted to work ships a great distance away, you located your station on a high hill not too far from the sea and put up as large an antenna as the masts and real estate could hold and the sheriff would permit. And he seemed to be always hanging around—for one reason or another.

In 1912, Federal Telegraph Company of Palo Alto, now part of ITT, opened to Hawaii the first transoceanic radio circuit from this country. The only detector for C.W. in those days was the "tikker"—spelled

for some occult reason with two "k's" and no "c." Probably the chief engineer had been weak on spelling in school. The tikker was a piece of piano wire scraping against a groove in a brass pulley driven by a 3600 rpm. induction motor. If the pulley were segmented like a commutator, a musical note could be obtained. Otherwise the tone was a frying or hissing sound, but it had a fair S/N ratio—even through Hawaiian static. Remember, we didn't have the heterodyne beat frequency in those days and no convenient local oscillator even if someone had thought of the beat frequency means of C.W. detection. The rates established at that time were lower than the Commercial Pacific Cable rates, so the new circuit did very well indeed. In fact, *all* radio circuits, no matter by whom established, opened up at rates substantially below those of the cables. First, we couldn't have attracted any traffic if we hadn't cut rates; second, there was no F.C.C. to tell us we couldn't. As for a certificate of public interest, convenience and/or necessity, no one would know what those fancy words meant and there was no one to grant such a certificate in any case. True, the Interstate Commerce Commission was vested with the regulation of domestic telegraph rates and telephone rates as well but, busy as they were with the railroads, they never seemed to get around to us.

Allocation of Frequencies

Those days of free enterprise, and I really mean free, came to an end the following year with the passage of the 1912 Act which became effective on December 13th. I remember that date with such precision because it was the date on my second "First Grade Commercial Operator's License." Administration of the Act was under the Department of Commerce. For the first time, transmitting frequencies were allocated—no more picking your own—and the greatest indignity of all was perpetuated on the hams: they were all stuck down on 200 meters or less! But they survived and as you know played a large part in showing what could be done with high frequency transmission.

In 1913, the first Marconi transatlantic radio circuit was built but I believe I am right in saying that it was never opened to commercial traffic before World War I. A little later, the German Telefunken transatlantic station was built at Sayville, Long Island, and the French T.S.F. Company built their station at Tuck-

(Continued on page 73)

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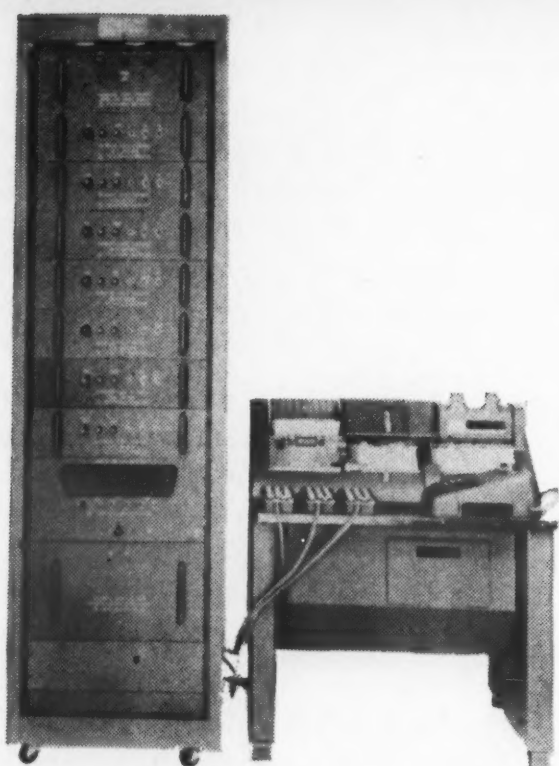
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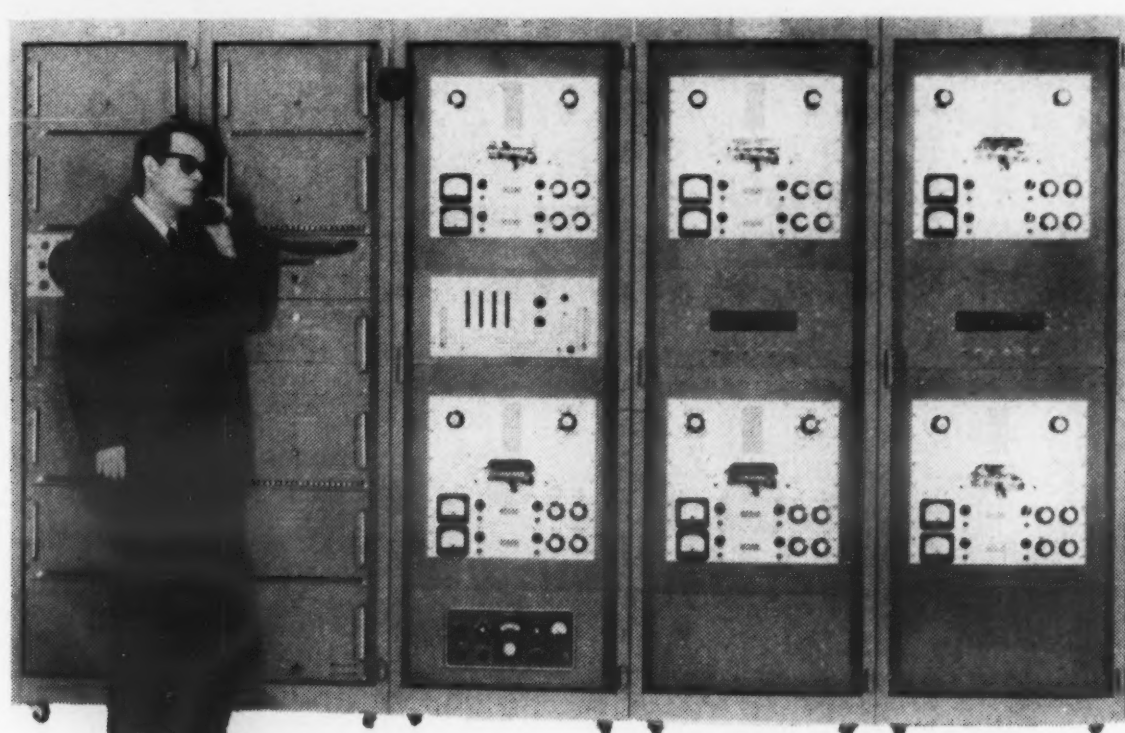
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erton. These latter two stations also were not opened to commercial traffic before World War I and with the Declaration of War against Germany in April 1917, all of these transoceanic stations were taken over by our Navy for the "duration."

Again in 1913, a significant action was taken in the so-called Kingsbury Commitment. This was an agreement by AT&T with the Department of Justice, or an offer by AT&T which was accepted by the Department of Justice, under which AT&T agreed to dispose of its ownership of Western Union, which it did in the following year, and agreed to stay out of the telegraph business itself.

By telegraph, AT&T meant the handling of messages. It did remain in the private wire telegraph business and in 1932 it entered into domestic TWX Service (or Telex as it is known in the international field). I mention this purely domestic affair because it had a bearing later on the international telegraph business.

In 1927, the Radio Act was passed which established the Federal Radio Commission. Administration of the 1910 Ship Act was transferred from the Department of Commerce to the new commission but regulation, such as it was, of the telephone and telegraph companies remained with the I.C.C. In the 1927 Act, there was adopted the policy that a cable company and a radio company could not be merged although a cable company, or its parent company, could build its own radio facilities subject to Commission approval.

In 1934, the Communications Act was passed which took over the provisions of the 1927 Radio Act and those provisions of the Interstate Commerce Act which dealt with the wire telephone and telegraph companies. The Federal Radio Commission was abolished and the Federal Communications Commission was established.

Domestic Telegraph Mergers

In 1943, the Communications Act, which permitted merger of domestic telephone companies but not telegraph companies, was amended to give the same right to domestic telegraph companies. Under this amendment, Western Union purchased Postal Telegraph-Cable Company which had hitherto acted as the domestic pick-up and delivery agency for the international carriers of ITT, All America Cables and Radio, The Commercial Cable Company, and Mackay Radio. The prohibition against merger of international carriers was continued.

Following World War I, General Electric founded Radio Corporation of America in 1919 and was later joined by Westinghouse as a major shareholder. The interest of the shareholders in the American Marconi Company was acquired by RCA together with Marconi's pre-war radio stations in this country which had never gone into commercial operation. With these resources at hand, RCA opened its first transatlantic radio circuit with the United Kingdom in 1920 and this was followed in rapid succession with the opening of circuits to Hawaii, Japan, Norway, Germany, and France. World War II and the post-war period saw the rounding out of the worldwide radio coverage of Mackay Radio and R.C.A.C. in a very large way.

Along with the growth of our international radio-telegraph circuits came the growth of the international radio-telephone circuits of AT&T. Following the purchase of basic De Forest patents, first for use as telephone repeaters, later as oscillators for carrier and radio-telephony, AT&T conducted its first transatlantic radio-telephone tests in 1915 from the Eiffel Tower. It opened its first commercial circuit to Great Britain in 1927. In the early '30s, circuits were opened with ITT to four countries in South America, to Cuba and Puerto Rico, and AT&T's subsequent expansion in the international radio-telephone field is well known.

Coaxial Submarine Cables

One of the most significant contributions in international communications came 10 years ago when AT&T and ITT joined in laying the first repeatered coaxial submarine cables—between Florida and Cuba. This was followed by TAT I to the United Kingdom and TAT II to France, with joint ownership of TAT II at the European end split between the French and German administrations. TAT III is projected as well as an AT&T transpacific cable to Japan. Following inauguration of the Puerto Rico coaxial cable jointly with ITT in January 1960, AT&T plans additional cables in the Caribbean.

The British, too, have been very active in this field. Their technique, in which ITT played a role, was used in part of TAT I. It is, of course, the basis for CANTAT, the new cable between the United Kingdom and Canada—the first link in a new Commonwealth chain of coaxial telephone cables encircling the globe. The new British cable to be laid across the Pacific from British Columbia to

Australia will touch our shores at Hawaii. Interconnection with AT&T cables there is to be expected.

But there are unresolved problems facing us in the international telegraph field. You will recall the Kingsbury Commitment of 1913—that AT&T would stay out of the telegraph message business. The telegraph carriers had a brush with AT&T when the first AT&T cable was laid to Hawaii. A similar problem arose when the Puerto Rico cable was projected. Happily, in the latter case, our difficulties were overcome by negotiation and out of that came the establishment of present AT&T policy toward the international telegraph carriers in respect of present and future AT&T wideband facilities in the international field, including satellites. That is, the agreement to lease facilities for telegraph purposes to the international telegraph carriers, including facilities for private wire, data transmission, and Telex, which in the international field are now accepted as "telegraph."

The major problem of the international telegraph carriers is that we are second-class citizens. Unbelievable as it may seem, we are the only common carriers under Federal regulation which are not permitted to merge. I have mentioned already that this has long been permitted to domestic telephone companies; it was extended to domestic telegraph carriers in 1943. Air lines, bus lines, railroads—all are permitted to merge, subject to approval of the cognizant Federal regulating agency. We ask no more than this same right.

Today, we cannot even jointly ask for a rate increase without being in violation of law. We needlessly maintain duplicate facilities, we are wasteful of capital and manpower as a result. A strong unified company would enable our industry to bargain more effectively, and in the national interest, with our foreign correspondents and competitors. If the present archaic law can be modified, which would be permissive only, labor can be better protected because there would be greater job security in a strong company. Greater use can be made of new techniques. Today our foreign radio correspondents must hold back to see what common automatic switching system will be adopted for telegraphy, including data, in this country.

The Satellite Problem

Where are we going with satellites? Perhaps a better question would be: where are the satellites going? First, there are the technical problems—

second, who will put them up?—third, what will be their role?

As to technical problems, satellites are divided into two classes: passive and active. No one appears to be making much of a case for the passive satellite so I think it is safe to say that the satellite of the future will be active. The big question is—how high? And here the thinking is really divided. To the scientist, the 23,000 mile altitude orbit is intriguing. He has a so-called stationary satellite, with respect to the earth's rotation. Three of them in space and you have a worldwide communication network at lower cost per channel mile than modern submarine telephone cables. Your telephone operating man doesn't buy that. For two-way voice communication across the Atlantic, a fairly short hop, you would have a .58 seconds time lag, including echo time, which does not meet acceptable toll standards. If you need two satellite hops, as from England to Australia for example, you would have a time delay, according to the British experts, of 1.2 seconds which would be completely unacceptable to the average telephone subscriber. So to the operating people, the stationary satellite at 23,000 miles height seems out.

Another school argues for 6,000

miles, in between the Van Allen radiation belts.

The AT&T plan, as filed with the F.C.C., calls for orbits at 2,500 miles. This is low enough to bring the time delay within reasonable toll tolerances. Moreover, it will be the best way to test the reliability of components against disintegration from radiation.

With these recent flare-ups from the sun, I would say that satellite engineering is very definitely of the "cut and try" type. We know that teletype communication via Courier IB was first class. But already, some of the components aloft have failed.

Who will put the satellite into orbit? NASA recently has gone on record as being willing to do the launching for communication companies on an out-of-pocket cost basis. AT&T has said it would not undertake to do the launching itself but would contract for this service. When you consider what the damage suits, both personal and property, would be if AT&T sub-contracted with a rocket manufacturer to put up a satellite which instead of going into orbit turned into a missile and came down on Los Angeles or Chicago, I think you will agree that there is much to be said for NASA doing the launch-

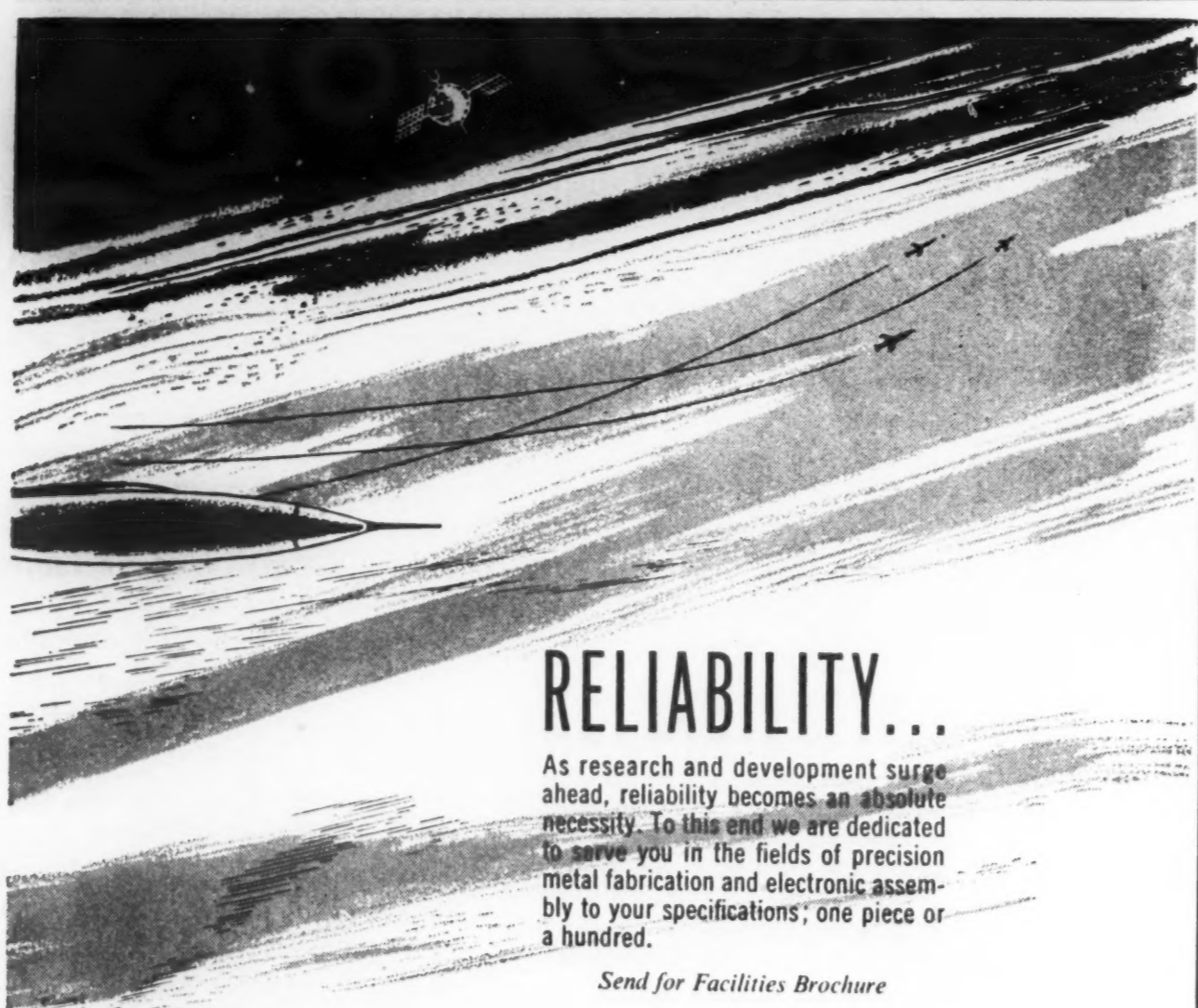
ing. So my advice to the air-frame and rocket manufacturers would be "Make your pitch for the rocket to NASA. Nobody but the Government could carry the insurance risk of a satellite which failed to go into orbit."

Before leaving the subject of satellites, I think we should reflect on another aspect of the problem. Accepting the thesis of the need for movable satellites (because of the unacceptable time delay of the stationary type), we must realize that once launched the satellite is no longer our property. It has simply become a medium of transmission or propagation, available to all companies, agencies, and nationalities. Once it passes out of sight and comes into the visible range of the people on the other side of the globe, friend or foe, it is just as much theirs to use as it was the original owner's. This is one of the problems. It can only be solved by international agreement in the same manner as we have passably allocated the radio spectrum during the past generation or so.

Satellites vs. Cables

What will be the role of the satellite in future communications? I think we must distinguish between military and commercial communications. The armed forces must plan on the basis of maintaining some sort of communications in the ZI and with our Allies on a basis of national survival in the unlikely event of an all-out nuclear attack. Here, it is contended, the satellite may be all that is left to us and consequently takes on an importance that I find hard to accept as realistic. I think the odds are greatly against a complete disruption of our present massive communication facilities in any circumstances.

The submarine cable in the past has been attacked by certain radiotelegraph interests which are now apparently quite happy to lease channels in it. I would like to emphasize one fact. As to vulnerability against cutting, no Allied cable was cut in either World War I or II where the Allies *had control of the seas*—control by either air, surface or submarine. I do not expect to see this country, supported by its naval allies, lose control of the seas in war. In peace time, we are not free agents because we have not yet resorted to war, with consequent exercise of our mastery of the seas, as an instrument of diplomacy. You can't blow a trawler out of the water in peace time for cutting your cables, whether accidentally or by design. But in war time, you've got no prob-



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lems with an enemy craft of any nature. I expect the modern repeated coaxial submarine cables to be around just as long as their predecessors.

I, therefore, must agree with those who feel that the unproved (and it is as yet only that) communications satellite will never *replace* terrestrial communications. It probably will be a useful supplement in future international communications.

I expect the future of international communications to embrace a merged American telegraph carrier using its own modern coaxial cables and radio, both direct and by satellite, if the latter proves practicable. AT&T will continue, of course, its planned expansion of telephone cables as will the British; and the Germans, French, and Italians will be following, I believe, in a few years. I do not think they will long be content with their present roles.

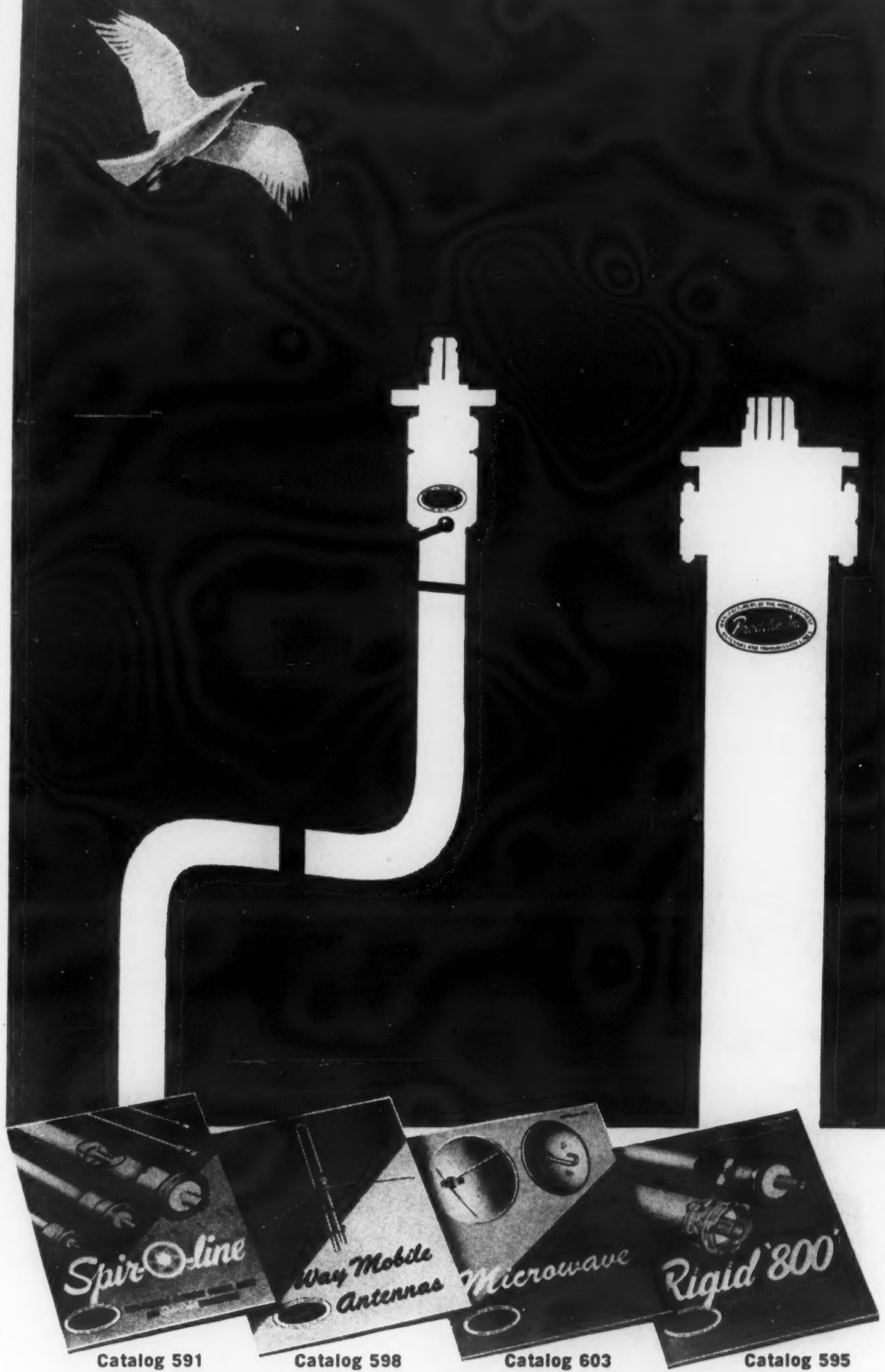
Conclusion

Finally, I should like to leave some personal thoughts about the role of communications in society and the world we live in. Some of this I have said before publicly—I hope it may stand repetition.

First of all, let us be humble in our concept of our work and our contributions. One way, perhaps, is not to be pompous in our nomenclature, our speech habits. I get just a little fed up at times with all the new words that are crowding our literature, our presentations. They seem to me just a little pretentious. Words such as "logic," "philosophy," "environment," "sophisticated." I don't think they ever originated with communicators but with people who for some reason are trying to pose as such. Even the modern term "system engineering" bothers me. I come from a school that figured if you sent a message or a telephone call from one point you had to receive it at the destination or you wouldn't get paid for it. So naturally you designed receiving equipment to work with transmitting equipment, whether by wire or radio. There was no percentage in building black boxes and later seeing if they could be worked together. Apparently we have been doing "system engineering" all the time in communication companies, only we didn't know it. Let us try to be simple in our language and not try to impress people—least of all ourselves. After all, the blessings of instantaneous telecommunications are not all we sometimes claim for them.

(Continued on page 76)

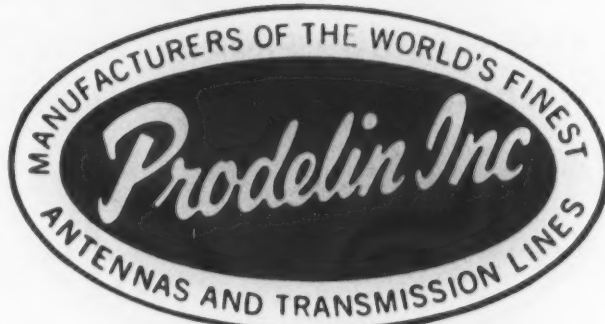
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For example, take the question of centralized authority, whether in business or military life. We are once again in a trend toward increased centralization—a trend wholly impossible in its present scope without modern communication networks. In international trade, the heads of business used to send out high-priced representatives to make decisions for them abroad, subject to periodic reports by mail and occasional visits from headquarters. Today, although you still send representatives abroad, the excellence of modern communications is such that you frequently exercise too close a check on them, deny-

ing them the initiative and responsibility that properly should be theirs. And when a really serious and urgent problem arises, the chances are that you take a jet and handle it yourself.

This method may be the only way to cope with today's worldwide complexities when business decisions have to be made in the field. But the fact remains that it is hardly the way to train subordinates in self-reliance, initiative, and responsibility against the day when the reins of leadership will be theirs.

In the military area, the excellence of modern communications tends, in my judgment, to work against the de-

velopment of the great military leader types such as we had in history. I like to think of the old days before electrical communication, when the British Admiralty sent Lord Nelson off with a fleet and the simple directive to find and destroy the naval forces of the enemy, last reported—say—off the French West Indies. To accomplish such a mission under sail in distant waters in those days frequently took months and, in the interim, you can imagine the state of mind not only of "My Lords of the Admiralty" but of the rest of the British Cabinet, cut off from communication with Nelson and thereby forced to rely on his courage, ability and judgment. Happily for the course of history, they couldn't do anything else.

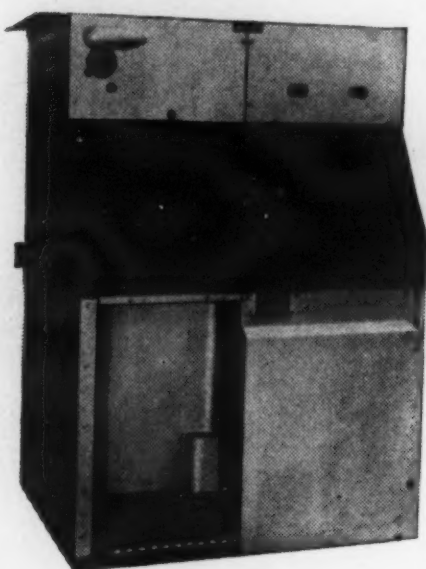
In World War II and Korea, with our excellent modern communications, commanders in the field or at sea had the titles of their historic predecessors but too often not the full authority of their positions. Too often, on both sides, the tactics of battle were determined, not by the commanders in the field or at sea, but by their superiors at home—who were frequently subject to domestic or international political pressures of the moment that may or may not have been in line with the long-range interests of the country.

Modern communications can, therefore, be a handicap to the commander in the field unless the superior at headquarters is his equal in stature. If the superior isn't, then it is better for communications to be not quite so fast, so the field commander can get the job done without interference.

When diplomacy in the old days failed to preserve a livable peace and war was necessary to restore it, military men in Nelson's day were expected to achieve victories so the job could be turned back to the diplomats in the shortest possible time. Far removed from the scene of battle, the diplomats had to bow out until the military men finished the job. Because of modern communications, this is no longer true.

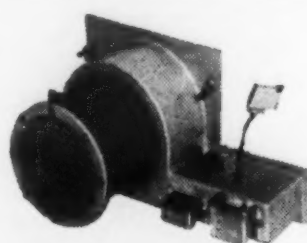
In closing, there's just one more cliché that I want to take issue with and that is the self-deluding statement that modern communications, in bringing peoples closer in touch with one another, tend to establish closer bonds and better understanding. This is utter nonsense. It is *how* these facilities are used and by whom—not their physical existence—which will determine whether peoples are brought closer together.

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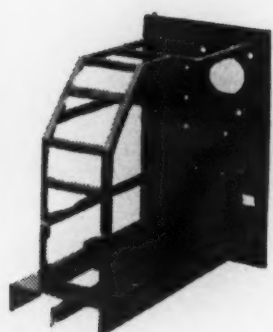
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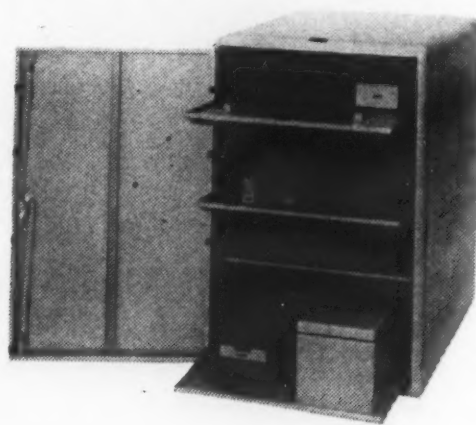


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Congressional Views

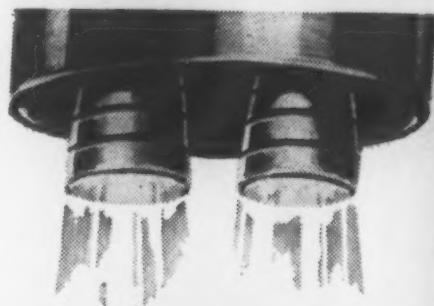
(Continued from page 34)

tion they might, while other phases of it get hit by three and sometimes four committees and get annual workovers. Much can be done in the Congress to coordinate its own work to treat parts of a subject as components of a whole. The Appropriations Committee is unaware of the studies of the Expenditures Committee (Government Operations) and vice versa. In one sense, though, I imagine the bureaucracy would just as soon leave the congressional process on a hit or miss basis inasmuch as the hits are so few and the misses so prevalent.

Mutual Understanding

I want to make a final plea for better mutual understanding. This has to do with all phases of endeavor by the military establishment. When the military receives a letter from a Congressman registering a complaint about this or that—the odds are 1,000 to 1 that he did not originate the complaint—a constituent did, a citizen, a member of the home front. The Congressman is just as much, more so, in the middle than the military person with whom the complaint is finally registered for processing. The Congressman has to get re-elected, at least to his way of thinking this is so. However, three good things can come from a complaint a Congressman passes on. (1.) The most important, if handled correctly, the relationship between the military and the home front can be improved. Most complaints need clarification, that's all. Good clarification creates good will. Thank goodness our society has never yet had to worry about the morale of the home front. But one reason we have not, I believe, is because of congressional letters and good processing of them by the military establishment. (2.) It gives the military organization a chance to check its own set up. It rings the circuit. Sometimes complaints suggest good ideas. (3.) It sometimes gives the Congress a better insight into how the laws are working or not working and this sometimes produces better laws.

To those who become impatient with government of, by and for the people, let me say that I know of no other system in history or in practical theory which permits the transition of basic political power from group to group and hence from generation to generation as smoothly. We saw an excellent example of this smooth transition on Friday, January 20, 1961.



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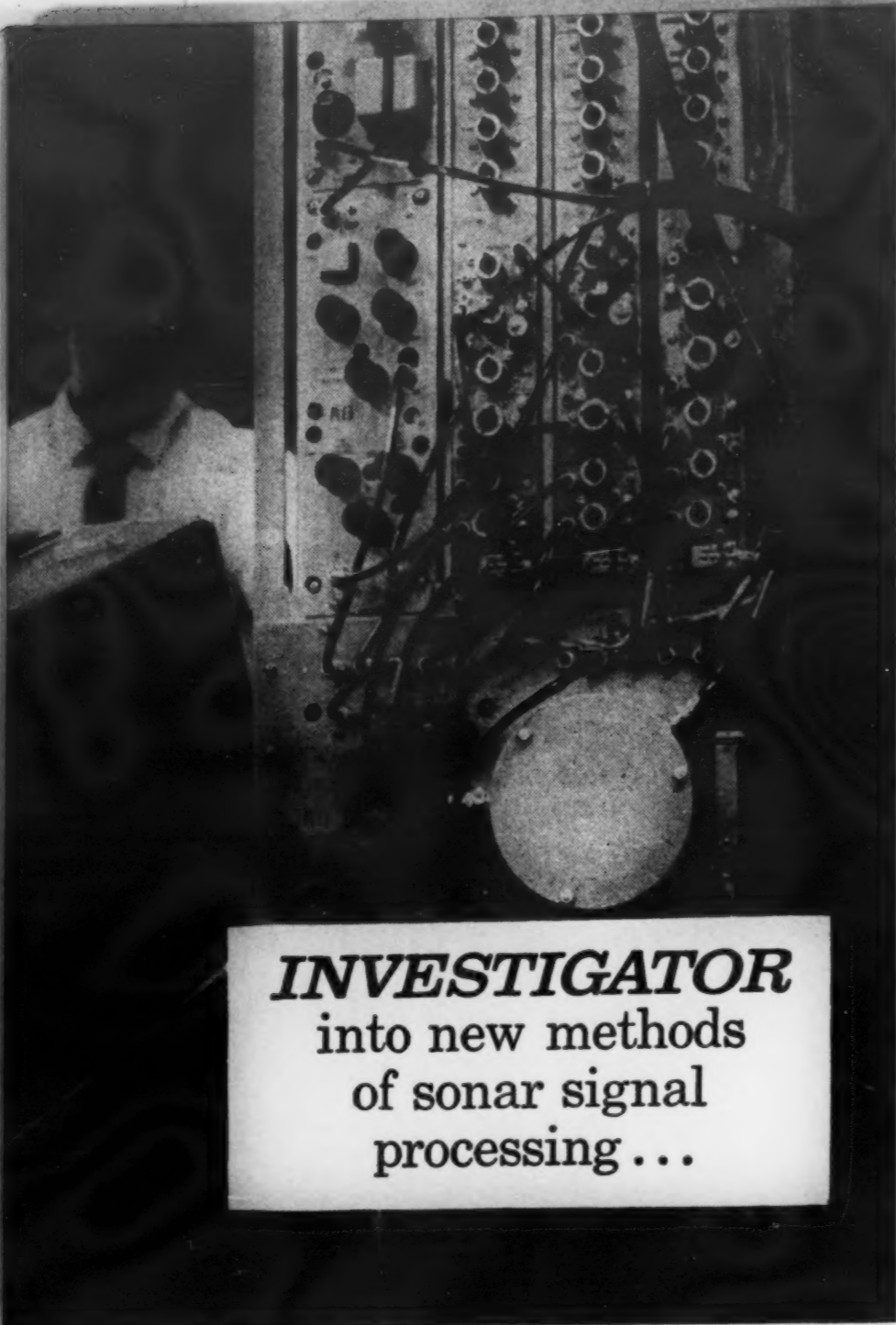
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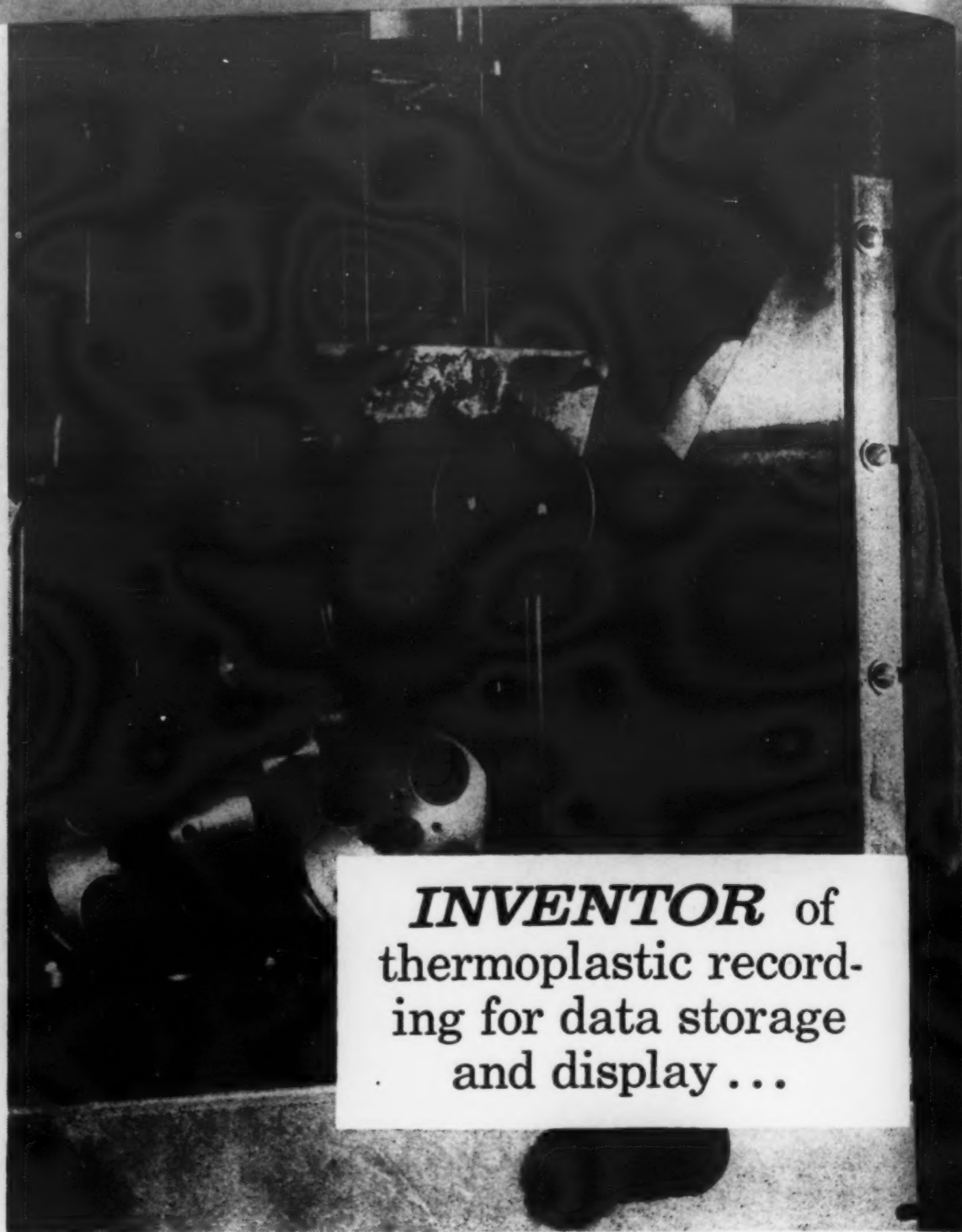


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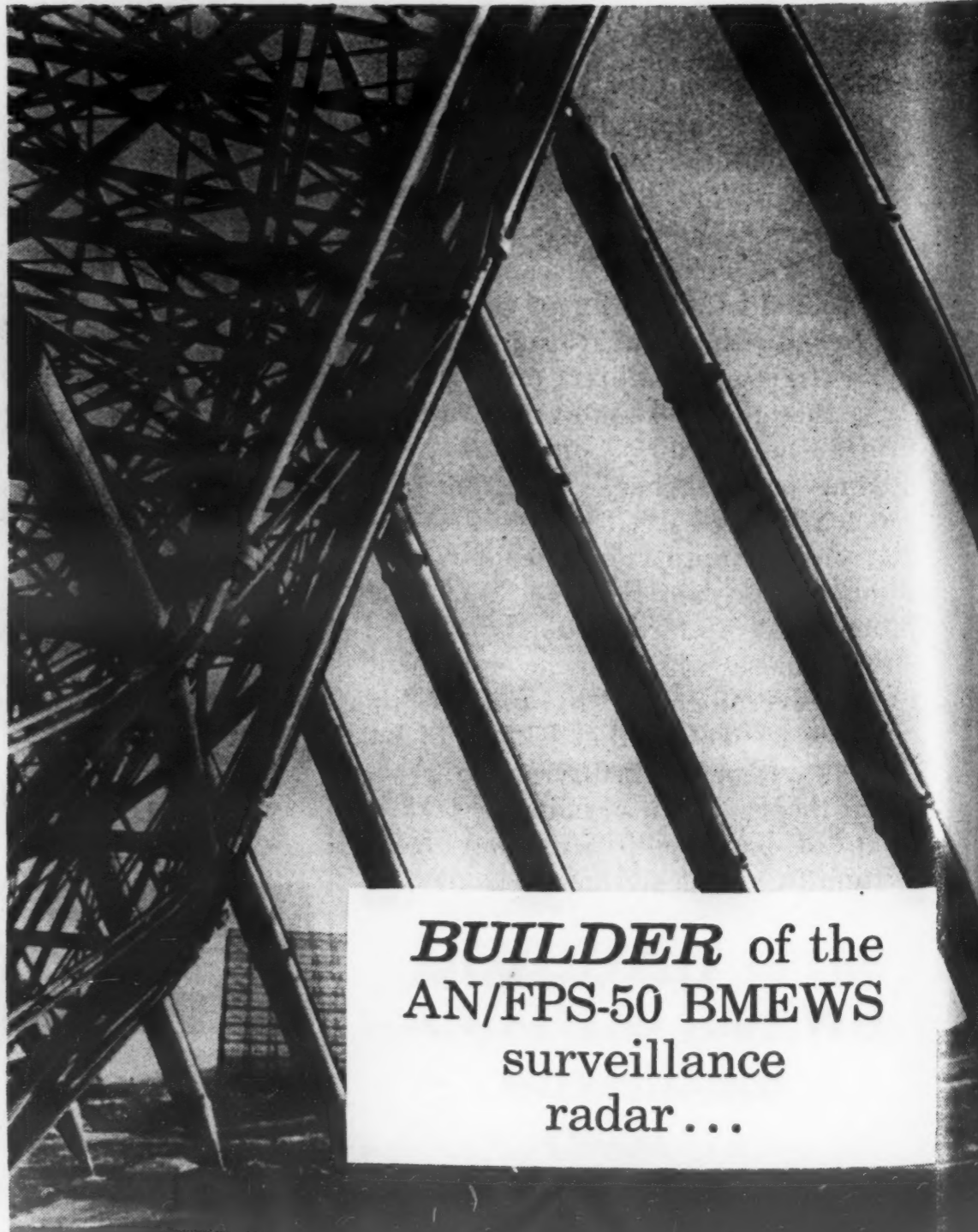


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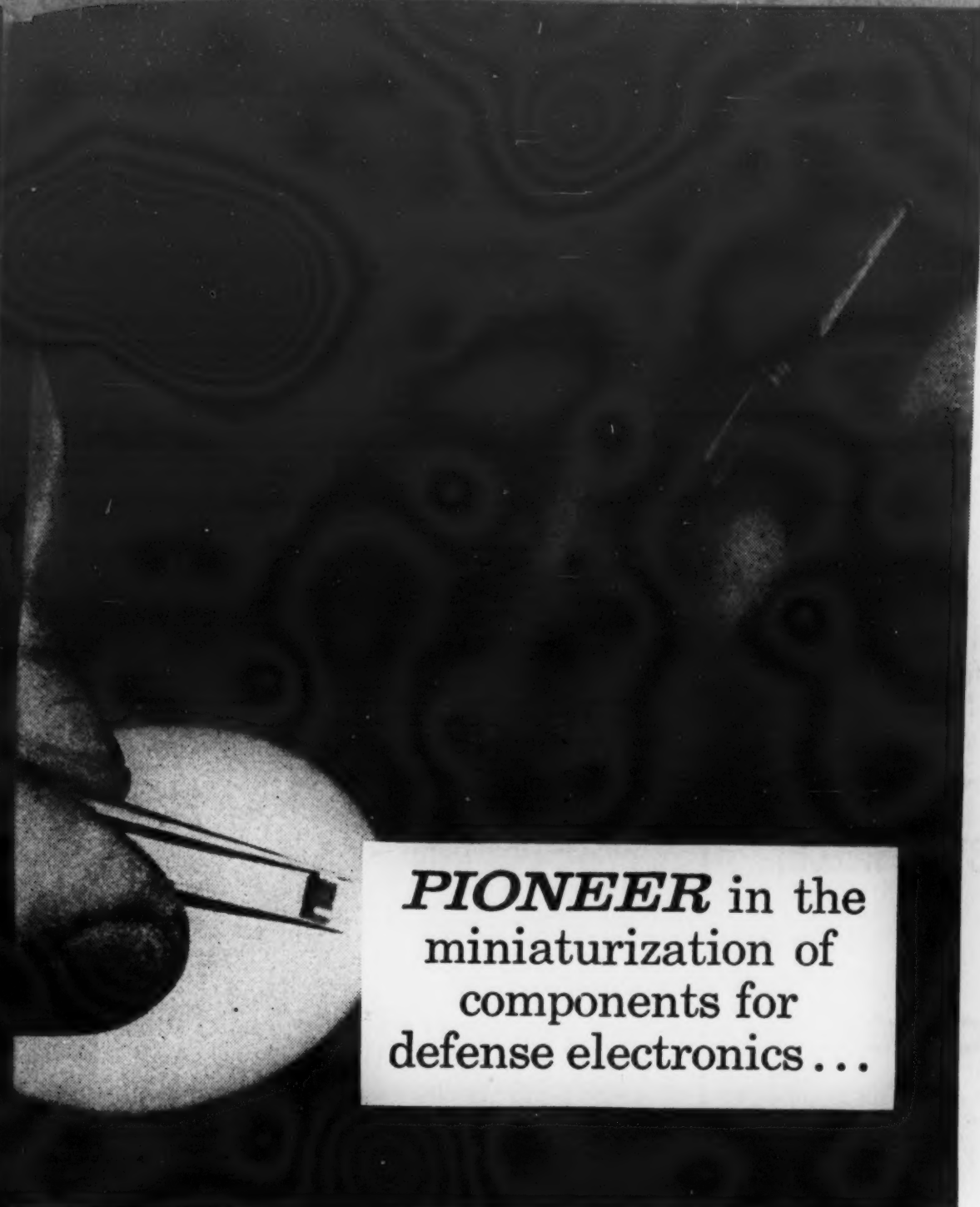
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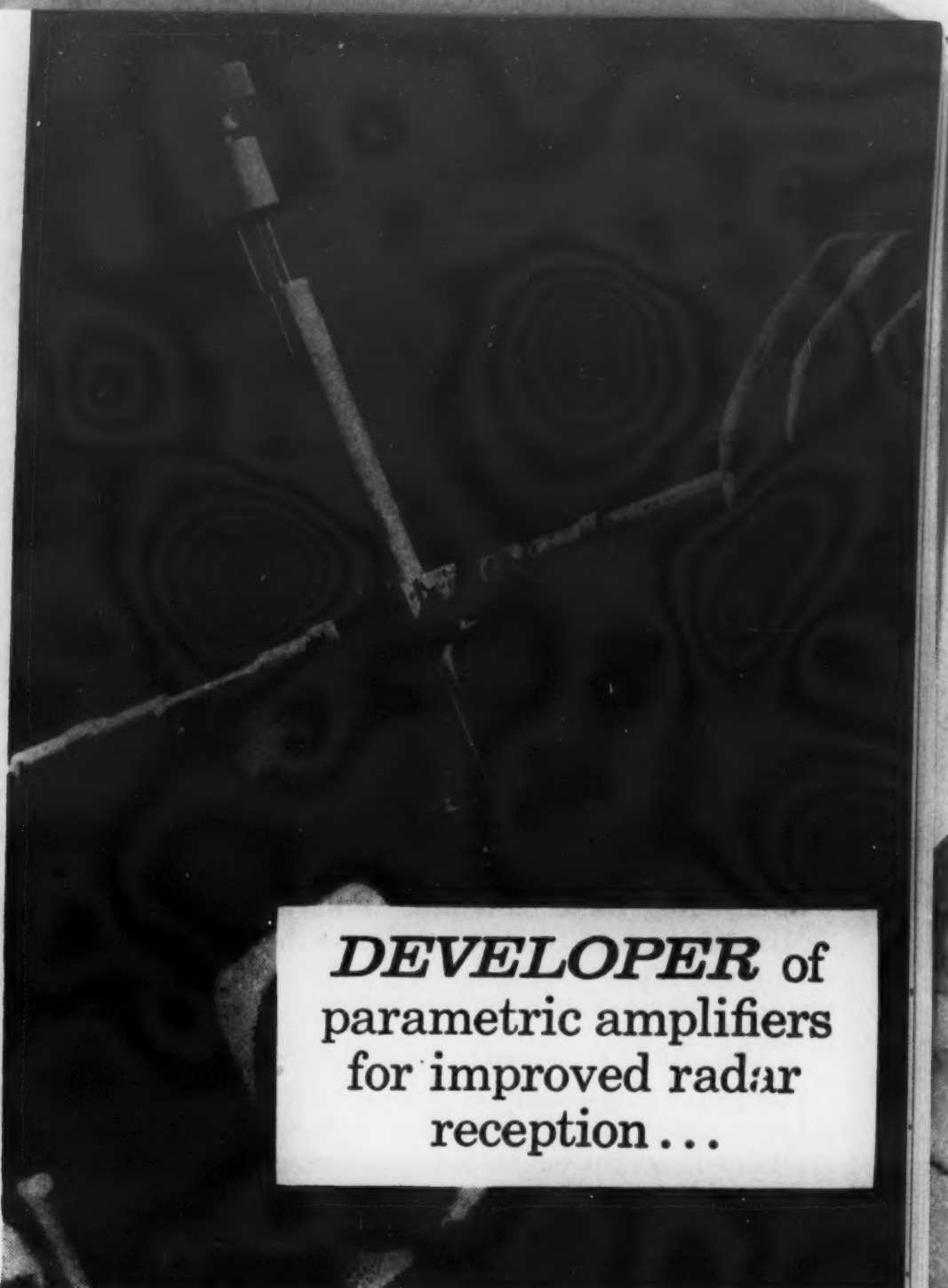
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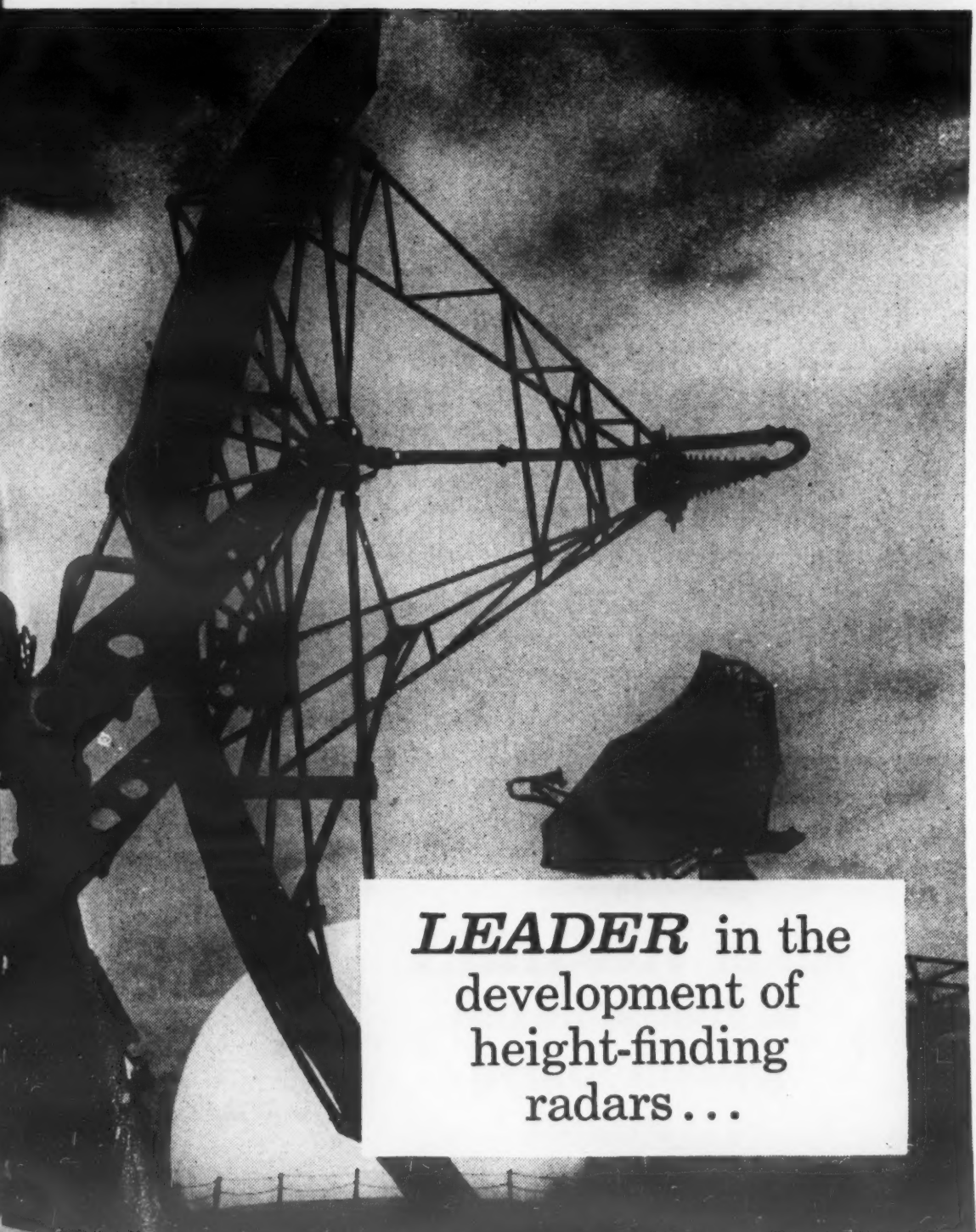


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PRESIDENT KENNEDY'S REVISED military budget sent to Congress on March 28 calls for a net increase of \$1,954,000,000 in new appropriations of which \$650 million will be spent in fiscal year 1962. These funds will raise the military budget for the coming fiscal year to \$43.8 billion. In new obligational authority the Navy receives \$1,485,000,000; the Air Force, \$412 million; the Army \$265 million, and the Office of the Secretary of Defense, \$46 million.

The budget increases are designed, according to Mr. Kennedy, "to chart a fresh, clear course for our security in a time of rising dangers and persistent hope." Major items contained in the revised message are additional funds for three missiles, Polaris, Minuteman and Skybolt, to boost the United States weapon arsenal of strategic missiles.

The Navy's Polaris program received \$1.34 billion in new obligational authority. This amount includes funds to begin construction of five additional Polaris submarines in 1961 and to construct ten additional subs in 1962. This will result in twenty-nine Polaris submarines in operation by the end of 1964 rather than 1966. Also, funds will be spent to develop the Polaris A3—the 2,500 mile range missile, and to increase the number of Polaris missiles used for practice firings.

Minuteman, the Air Force's air-to-ground missile, received an increase of \$96 million. Involved will be additional funding for research and development to improve reliability, accuracy, range and reentry; an increase in the allocation of missiles for practice firing; replacement of the three mobile Minuteman squadrons funded in January by three fixed-base squadrons; development work on the mobile version will continue; and a doubling of the production capacity for Minuteman.

The Air Force Skybolt, an air launched ballistic missile, received an additional \$50 million. The Skybolt's "successful development and production may extend the useful life of our bombers into the missile age."

The nation's space programs were included in the revised budget message. An additional \$226 million will be spent for Dyna Soar, Advent, Defender, Discoverer, "and certain other programs."

Midas program for detecting missile launchings with satellite-borne infrared sensors received an increase of \$60 million to accelerate completion of the development phase of the program.

Other items receiving increased funds for strengthening and protecting our strategic deterrent and defenses include Strategic Air Command ground alert forces which received \$44.6 million to permit about half of the B-52 and B-47 forces on ground alert and to provide bomb alarm detectors and signals at key warning points; Command and Control facilities which received \$16.4 million to improve the invulnerability of strategic command and control posts or centers; Air Defense Capability which received \$23 million to permit the air defense system to cope with a combined ballistic missile and manned bomber attack.

A SIGNAL STAFF REPORT

Budget Revisions

The budget revisions include funds for increasing limited war forces. Items include money for research, development and procurement of limited warfare weapons. An additional \$122 million is recommended to speed up limited warfare research and development programs; to initiate new programs, especially non-nuclear weapons and equipment; to increase fire power, mobility and communications. An additional \$230 million will be spent for such items as helicopters, rifles, electronics and communications equipment, non-nuclear weapons, improved ammunition and torpedoes. Funds totaling \$45 million will be used for developing an advanced tactical fighter emphasizing non-nuclear capabilities.

Also recommended is \$25 million for modification of the F-105 tactical fighter to improve its capability to handle conventionally armed ordnance items, and to increase its suitability for airstrips of all types.

Funds are provided for increased personnel, training and readiness for conventional forces. \$39 million is recommended for increases in military personnel. This amount would provide for 13,000 additional men for all the services—Army, 5,000; Navy, 3,000; Air Force, 2,000; Marines, 3,000. An additional \$65 million is provided for increased readiness training of Army and Air Force units.

The revised budget calls for reductions in several areas. First, cancellation of the last two squadrons of Titan missiles originally contemplated. These would have cost \$270 million. \$100 million in the 1962 budget can be saved by this adjustment. Second, acceleration of the phase-out of a number of B-47 bomber wings; 1962 savings, \$35 million. Third, immediate phase-out of the subsonic Snark airbreathing long range missile; 1962 savings, \$7 million. Fourth, cut-back on the B-70 manned bomber program. The B-70 will not be developed as a full weapons system, but "the program will be carried forward essentially to explore the problems of flying at three times the speed of sound with an airframe potentially useful as a bomber, with the development of a small number of prototype aircraft and related bomb-navigation systems." \$220 million requested for 1962, \$138 million less than the amount included in the January budget. B-70 program will cost \$1.3 billion before its completion in 1967, but this amount is \$1.4 billion less than that previously planned.

Fifth, the entire nuclear-powered aircraft program is to be transferred to the Atomic Energy Commission as a non-defense research item and will include termination of development effort on both approaches to the nuclear power plant, comprising reactor and engine, and on the airframe. However, scientific research and development will be carried forward in the fields of high temperature materials and high performance reactors. 1962 savings, \$35 million.

Sixth, cancellation of the development program of the Eagle air defense program for the fleet, with estimated savings of almost \$57 million in 1961 and 1962.

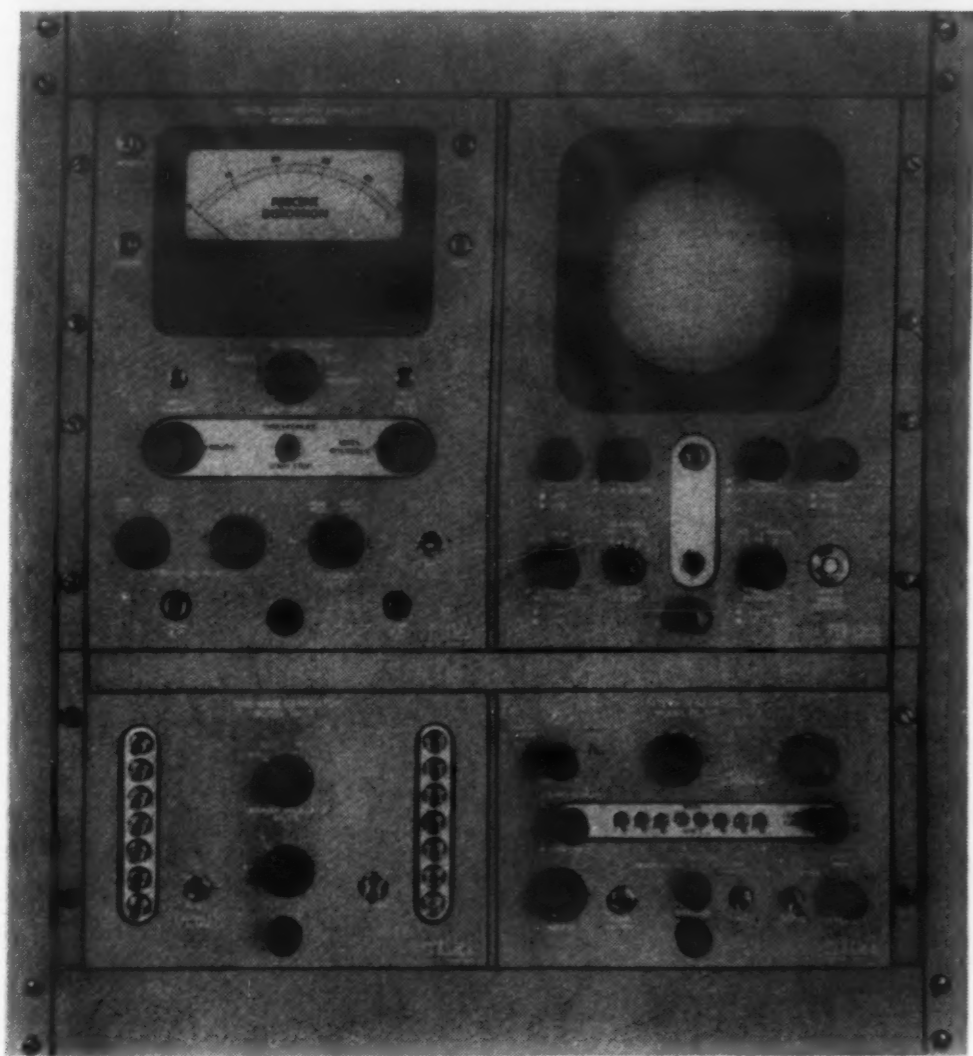
Seventh, cancellation of plans to install Polaris missiles on the cruiser *Long Beach*, with savings in 1962 of \$58 million.

Eighth, inactivation of 73 domestic and foreign installations. Although no net savings are expected to be realized from these inactivations in 1962, in subsequent years savings are estimated at \$220 million per year.

With these revisions, the military budget proposed by President Kennedy calls for new obligational authority totalling \$41,371.1 billion in fiscal 1961 and 43,794.3 billion in fiscal 1962. The net expenditures are \$42,500 billion in 1961 and \$43,800 billion in 1962.

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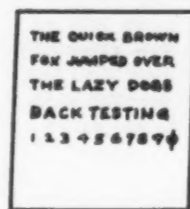
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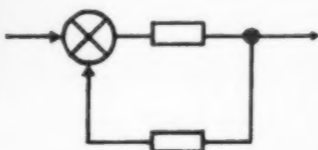
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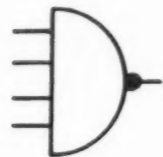
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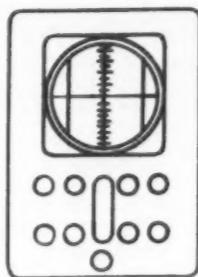
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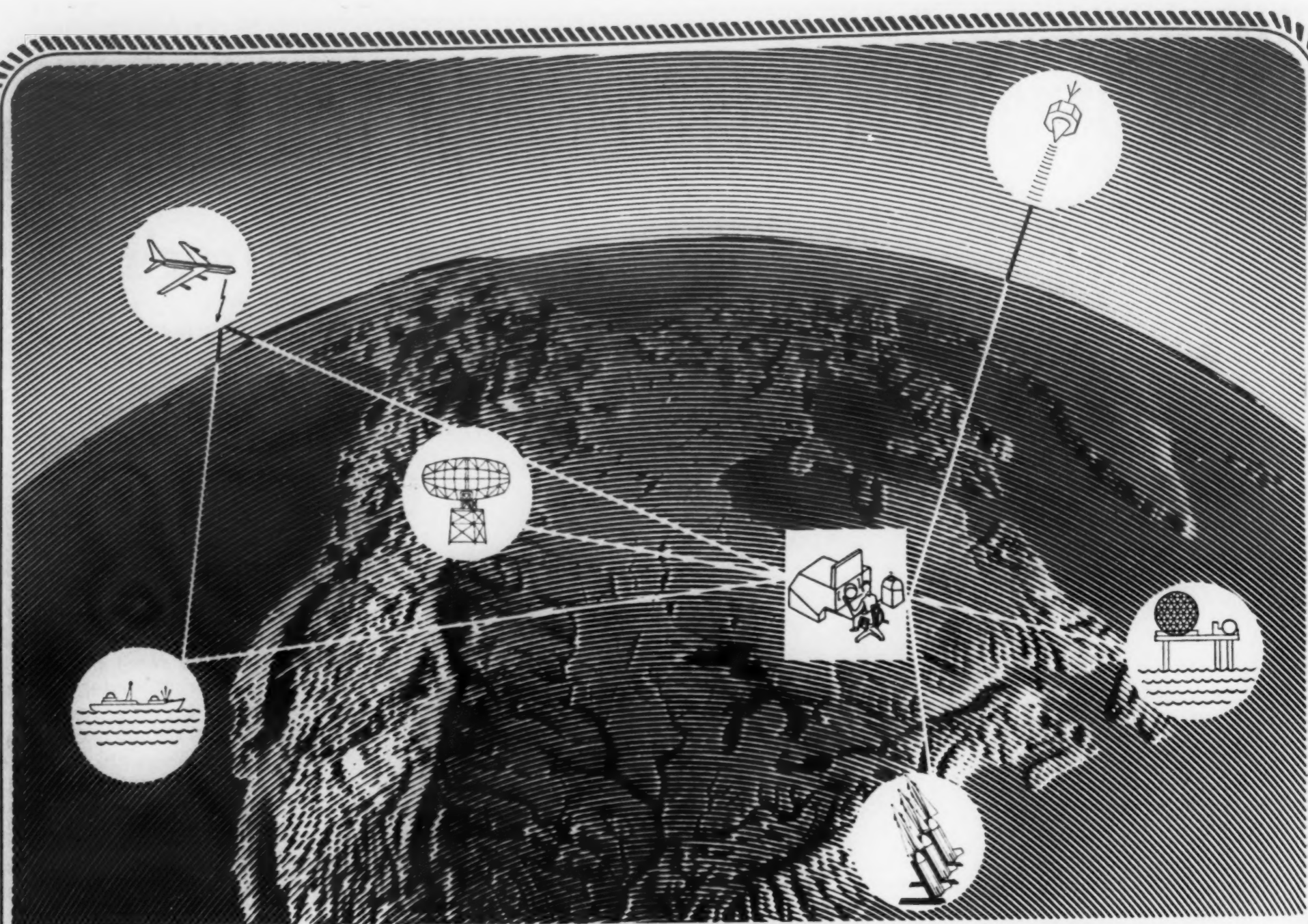
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Your AFCEA-SIGNAL staff attended the recent International Radio Engineering Show in New York both as reporters and exhibitors. We want to thank the many AFCEA members who stopped at Booth Number 4226B to talk to us.

The press was privileged to meet Dr. Franz Ollendorf, Overseas Vice President of IRE and Research Professor at the Technion-Israel Institute of Technology at the opening press conference. In his discussion of electronics in the near east, Dr. Ollendorf stated that development is hindered by a lack of either a vacuum tube or a transistor factory. However, education in electronics has reached a very high level in Israel, both on a theoretical and a practical level. Israeli scientists are particularly proud of the work being done in medical electronics to alleviate the tribulations of the deaf and blind.

Lloyd V. Berkner, IRE President, spoke with enthusiasm of the prospects of the industry over the next ten years. He predicted growth in the four major areas of communications, automation, space and solid state physics.

Space precludes a discussion of many of the excellent papers presented at the Show, but we would like to mention briefly some of the best.

Technical Discussions

The laser radar became experimentally possible only last July with the historic achievement by T. H. Maiman of the first operating laser light source, according to a group of engineers from the Hughes Research Laboratories. Among the many potential applications of the laser, the laser radar appears to be one of the most promising. The ruby laser is a good light source for an optical radar because it provides intense pulses of monochromatic light in a sharply directional beam. The intense beam of red light is generated in an efficient manner in a ruby crystal with linear dimensions of the order of one inch. The ruby is driven by a pulse of white light from a gaseous flash tube. The pulsed nature of the device is compatible with pulse-ranging techniques.

The red light output, at 6943 Å, is confined to spectral band of the order of 0.1 Å in width. This allows narrowband spectral filtering to be employed at the receiver to discriminate against optical "noise." By virtue of the coherence of the laser, the light output is collimated into an extremely narrow beam, making high

angular resolution possible with no auxiliary optics. Existing ruby lasers provide beamwidths of less than one degree.

The Voice of America, the international broadcasting service of the U. S. Information Agency, speaks for America in more than 26 different languages. The technical system which makes this possible and future plans for strengthening the network, were discussed by E. T. Martin and G. Jacobs of USIA. Present facilities of the Voice of America in continental United States consist of thirty short-wave transmitters at seven locations ranging in power from 25 to 200 kilowatts. Overseas installations include nine relay stations with 47 transmitters ranging in power from 35 to 100 kw.

highlights of the **IRE** show

A SIGNAL STAFF REPORT

A new transistor material—gallium arsenide—was discussed in a paper by M. E. Jones and E. C. Wurst of Texas Instruments, Inc. The two engineers reported that the new compound has several advantages over silicon or germanium, the materials now most commonly used in transistors. Gallium arsenide is expected to allow transistors to be made which will be capable of operation at 350-400 degrees Centigrade, considerably higher than those tolerated by silicon transistors.

The report added that the gallium arsenide transistors have already been produced in prototype form and have shown themselves capable of operation at higher frequencies as well as higher temperatures. In addition, the faster switching techniques made possible with the new devices give every appearance of making them superior in many applications to either silicon or germanium transistors.

A new kind of radar which looks straight up at the sky and prints out a paper tape recording of the height and density of clouds to provide advance information about ap-

proaching storms and overcasts was discussed by engineers of the Olympic Radio and Television Division of the Siegler Corporation. Now in service with both the Air Force and the United States Weather Bureau, the system operates by means of a continuing stream of radar pulses sent out by a transmitter at a frequency of 35 kmc. A 7-foot reflector dish focuses the radar signal like a piercing light ray into a very narrow beam which penetrates clouds to a height of 60,000 feet. It even detects clouds too diffused to be visible to the naked eye.

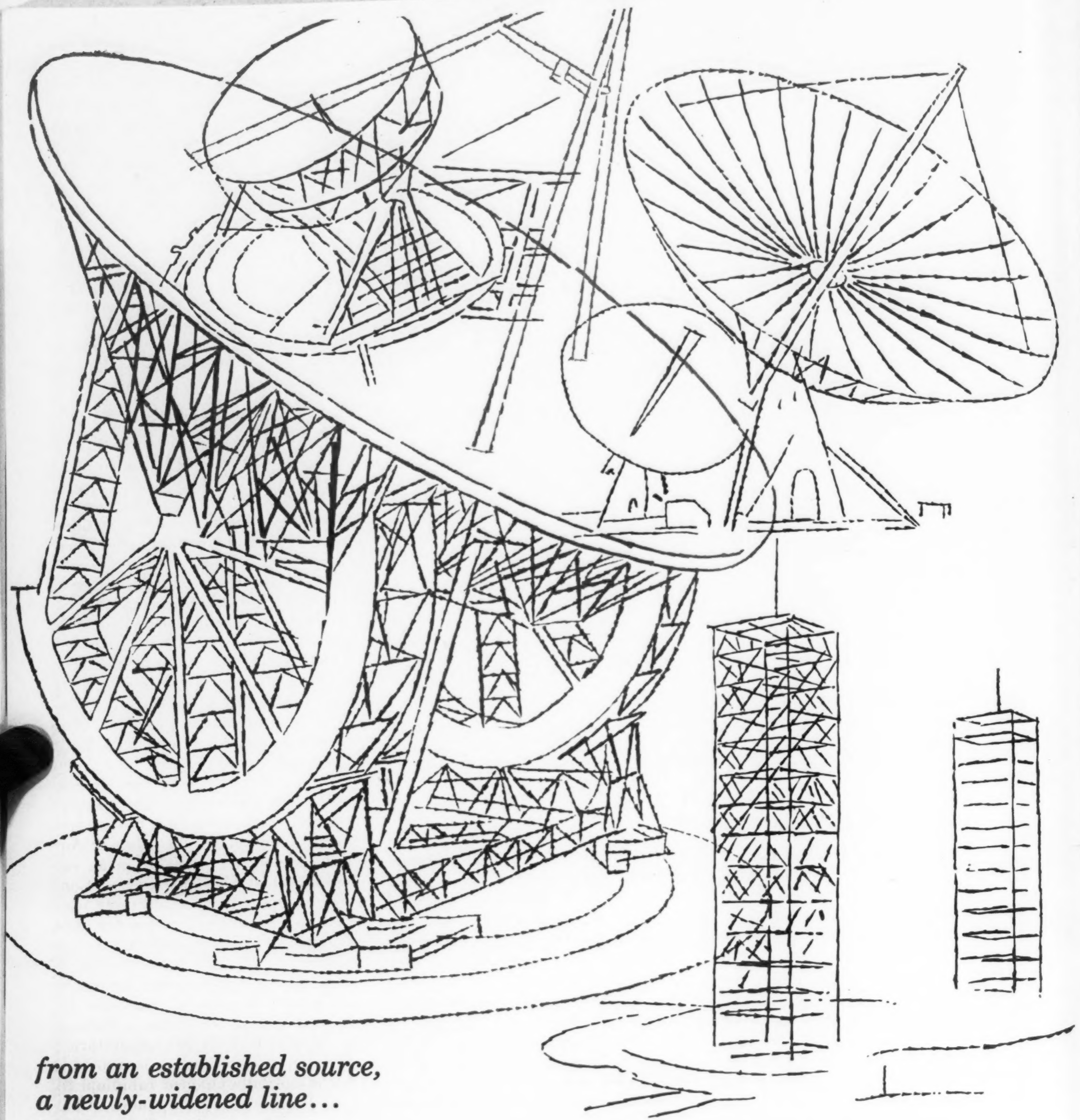
New Products

The Martin Company exhibited a new communications system that makes use of digital techniques. Called RACEP, this discrete address system is a portable communications equipment that provides telephone-type service without wires or switching centrals. It is a broadband system in which voice is converted to coded pulse groups in a time-frequency matrix, and then processed for transmission in the VHF or UHF regions. The receiver reconstructs the voice message by converting the received information pulses into conventional analog audio signals. With this code-signal system, the user calls — discretely addresses — any other user exclusively. The uniqueness of each subscriber's time-frequency code makes the Discrete Address system very reliable in an environment of high interference. Conference and command override user options give this system the broadest possible application—military or civilian.

A fully portable atomic frequency standard for general use was exhibited by STL Products, a division of Space Technology Laboratories. Frequency stabilization is provided by an optically pumped rubidium 87 cell. Weighing only 45 pounds, it has a long term stability of 1 part in 10^{10} RMS and a short term stability of 2.5 parts in 10^{10} RMS. The unit is now available at a price of \$22,500.

The epitaxial "growing" of semiconductor materials makes possible germanium and silicon devices far more versatile and efficient than conventional types of transistors, engineering officials of Sylvania Electric Products Inc. stated in their announcement of a new line of transistors. Dr. William J. Pietenpol, Vice President and General Manager of Sylvania's Semiconductor Division, described the new epitaxial technique as achieving "what has

(Continued on page 91)



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THE LIONEL CORPORATION Hoffman Place, Hillside, New Jersey



midwest program on airborne television instruction

by DR. B. D. GODBOLD, Executive Vice President, The Midwest Program on Airborne Television Instruction

INSTRUCTIONAL TELEVISION, while still in the process of development, is not uncommon today. In fact, it was more than a decade ago that the military services pioneered this combination of education and television.

Experts agree that television has taken great strides toward the improvement of education. Now a new technological ingredient is being added which greatly expands the potential of both television and education.

The new ingredient is an airplane. It is part of a bold experiment being conducted by the Midwest Program on Airborne Television Instruction (MPATI), headquartered at Purdue University in West Lafayette, Indiana. A four-engine DC-6AB, loaded with taped instructional courses made by teachers screened from the best available in the country, leaves Purdue University Airport for its assigned pressure altitude of 23,000 feet over Montpelier, Indiana, 40 miles south of Fort Wayne. One hour and 10 minutes after leaving the ground, the airplane begins tacking within a circle of 10-miles radius or less and transmitting air-to-ground signals to a potential 5,000,000 students in six states. The telecast area—encompassing some 127,000 square miles and 13,000 schools—covers parts of Illinois, Indiana, Kentucky, Ohio, Michigan and Wisconsin.

A demonstration period, consisting of signal patterns and later some taped courses, is being carried out this spring. A full academic year of courses—on the elementary, secondary and college levels—will begin September 1, running six hours a day, four days a week. Two 20 or 30 minute lessons are telecast every hour over each channel, or a total of 12 lessons a day during the demonstration period. During the 1961-62 academic year, this total will increase to 24 lessons a day.

A survey by the MPATI staff in late 1960 indicated that more than half a million students in 16,000 classrooms anticipated looking on during these early telecasts. More than 20 schools in the six states have been equipped without cost by television equipment manufacturers to serve as model schools for observation by area teachers, school board members and others. Ten teachers, screened from more than 300 applicants, are currently at production centers around the country recording their courses on tape.

The demonstration period gives the schools an opportunity to observe the courses, check the quality of the signals received and install and test their receiving equip-

ment. Schools are encouraged to install for line-of-sight transmission because hilly terrain, tall buildings and other variables will affect reception. Adequate signals were transmitted from an airplane up to 225 miles in 1948 by Westinghouse Electric Corporation in an experiment labeled "Stratovision."

MPATI signals can be received in the classroom by two systems. One is the individual receiver installation where each set is equipped with its own antenna to pick up the UHF signal. (Most television sets are built to receive VHF signals only.) The alternative is the system installation whereby a master outdoor antenna picks up the UHF signal and feeds it through a converter and amplifier to VHF receivers in the school.

Costs of Airborne Transmission

The cost of equipping a classroom (borne by the school) depends on the distance of the school from the airborne station. The greater the distance, the more elaborate the antenna must be. The cost per room of the individual antenna system remains constant regardless of the number of rooms. This is estimated at \$400 for schools within a 100-mile radius of Montpelier. The system installation costs less per room, however, as the number of rooms increases. For instance, the equipping of two classrooms at a school within 100 miles of Montpelier would cost \$800 per room; 20 rooms about \$280 per room.

Capital and operating costs of airborne transmission are estimated at about one-half that of equivalent ground-based facilities. In fact, it would require 14 ground-based stations to cover the same geographic area.

If the project merits continuation after June, 1962, a permanent organization will have to take over its management and financing. What form this organization might take is debatable, but it likely will have to be an interstate or inter-school district compact operating on a tax-supported or voluntary fee basis.

The experimental program is being financed by a \$4,500,000 Ford Foundation grant and contributions from private industry. The total project cost is \$7,750,000.

Three Megacycle Band Width Transmission

Transmission from the airplane initiates from two video tape recorders, one for each UHF channel (72 and

76) assigned by the Federal Communications Commission. Concurrent with the MPATI experiment, CBS Laboratories, Inc., with the cooperation of the Minnesota Mining and Manufacturing Co., are studying narrow-band telecasting. This technique would permit broadcasting a video image within a three-megacycle band width instead of the conventional six-megacycle band, and has the potential of doubling the number of courses which could be carried over a standard UHF channel. With an eventual three channels and the use of the narrow-band technique, sponsors of the airborne project visualize the possibility of telecasting 72 separate lessons a day.

Transmissions from the two video tape recorders feed through a control console (with monitor attached) into two parallel five-kilowatt peak power transmitters. These transmitters feed into a multiplexer and then into a gyro-stabilized antenna, extending 24 feet below the airplane.

The antenna assembly consists of an 11-foot, slotted-cylinder coaxial antenna mounted on a 21-foot mast. The entire assembly pivots from a horizontal position for take-off and landing, to a vertical position for telecasting. As the airplane banks and turns, the antenna pivots to maintain its vertical position.

Power for the broadcasting station is supplied by an auxiliary unit mounted in the rear of the plane, a gas turbine driving an 85-kilowatt, 400-cycle generator. Most of the equipment has been converted to operate from this generator, but four kilowatts have been converted to 60-cycle power for synchronizing the television sync generator and other equipment, such as the monitor console.

A vidicon camera chain is being used for reading opaque cards during station breaks.

The standard MPATI aircrew consists of a pilot, co-pilot and flight engineer to man the airplane and one engineer and two technicians to handle the telecasting equipment.

A second MPATI airplane, identical to the first and containing a duplicate set of taped courses, serves as a standby in case of mechanical or weather difficulties. Both airplanes were equipped by Westinghouse. They were purchased from Slick Airways, Inc., for whom they served as passenger airplanes on far eastern Pacific runs.

Each airplane grosses about 88,500 pounds when in the air, including 13,000 pounds of television and other special equipment. Fuel amount is calculated so that they can land as far away as Atlanta, Georgia, if weather conditions prevent landing at Purdue.

A study of U. S. Air Force meteorology records and the use of the standby airplane have led engineers to predict that MPATI can remain on station better than 95 per cent of the time.

Tape Processing Center

All lessons transmitted from the airplane are first recorded on video tape. At a Tape Processing Center on the Purdue campus, experts in both education and television review the taped courses for approval or rejection. The center is composed of three principal parts: three video tape recorders for duplicating tapes; three viewing rooms with monitors hooked up to the tape recorders; and, a file area with room for about 3,500 tapes.

It is estimated that the first 12 courses produced total about 780 miles of tape. The airplane carries two days' tapes so that if it is forced to land at a distant airfield, it is able to telecast the following day without reloading.

The center keeps duplicates on file for five weeks of courses—a total of 240 tapes during the demonstration period.

Future of Airborne Television

Aviation and television technology have been combined to turn a new light on American education. Even in aviation, the project may have important implications. Brigadier General Milton W. Arnold, USAF (Ret.), has said:

"This project is of real importance to the aviation industry, representing a 'breakthrough' into a new field of usefulness for aircraft. We are hopeful that the science of aeronautics will be advanced through this new technique of education."

In education, airborne television represents a means to upholding quality in the face of a steady increase in enrollments in American schools and colleges. It is not aimed at replacing the teacher. Airborne television's purpose is to supplement teachers and to free them from involved classroom presentations for the more challenging tasks of working with individual students, helping students apply new knowledge and fostering independent study and research.

If the airborne project proves successful, it may encourage similar regional undertakings in other sections of the country. The airborne system could be used for broadcasting courses in adult education. In fact, MPATI will use it for such this summer as a means of assisting classroom teachers attending workshops throughout the region. The system also might have implications for speeding the educational process in underdeveloped nations where illiteracy is a big barrier to learning. The teaming up of television and aviation would seem to open up possibilities faster than mankind can master them and put them to use.



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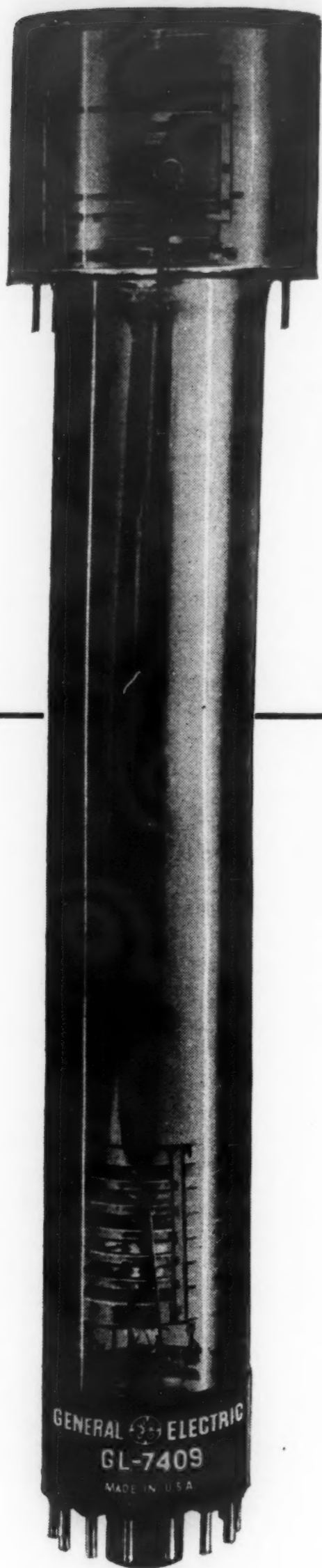
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Image Orthicon Type	Typical Applications	Features	Spectral Response (Angstroms)	SENSITIVITY (photocathode illum. in f/c; 100% Contrast Chart; 1/30 Sec.)
GL-7409 (Z-5358)	Missile- and Satellite- borne Systems Fire Control Drone Guidance	Ruggedized High Sensitivity Magnesium Oxide Target Non-burn-in Storage Capabilities	3200-6950 4500-Peak (S-10)	500 TV Lines at 10^{-5} f/c
GL-7538 (Z-5294)	Low-light-level Surveillance Space Navigation Electro-optical Telescope Systems	High Sensitivity Magnesium Oxide Target Non-burn-in Storage Capabilities	3200-6950 4500-Peak (S-10)	500 TV Lines at 10^{-5} f/c
ZL-5395*	Aerial Mapping Passive Detection Systems Spectrographic Detectors	Near-Infrared High Sensitivity Magnesium Oxide Target Storage Capabilities	3200-10,800 8000-Peak (S-1)	200 TV Lines at 10^{-5} f/c (No filter)
GL-7967* (Z-5396)	Extreme Low-light-level Surveillance Orthicon Intensifier Applications Underwater Observation	Supersensitive Magnesium Oxide Target Storage Capabilities	3200-7400 4250-Peak (S-20)	300 TV Lines at 10^{-5} f/c
GL-7969* (Z-5453)	Missile Detection Spectrographic Detectors Underwater Observation	Ultraviolet High Sensitivity Magnesium Oxide Target	2500-7000 3800-Peak	500 TV Lines at 10^{-5} f/c
GL-5820	Educational TV Video Taping Standard Monochrome Broadcast	High Sensitivity Stable Performance	3200-6950 4500-Peak (S-10)	Scene Illumination: 100 f/c
GL-7293 (field- mesh)	Educational TV Video Taping Standard High-quality Monochrome Broadcast	Improved Landing and Shading Improved Corner Focus Sharp Black-to-white Transition	3200-6950 4500-Peak (S-10)	Scene Illumination: 100 f/c
GL-7629	Closed Circuit Training Applications Special Monochrome and Color Broadcast	Supersensitive at Low Light Levels Magnesium Oxide Target Non-burn-in Storage Capabilities	3200-6950 4500-Peak (S-10)	Scene Illumination: Color—as low as 5 f/c Monochrome—as low as 1 f/c

*Ruggedized versions available (ZL-7805, ZL-7806, and ZL-7807, respectively). Will withstand frequency in excess of MIL requirements, and DC acceleration in excess of 90 G's.

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FOR INFORMATION on the above tubes, or for any specialized requirements—including Government-classified projects, contact the camera tube representative in the nearest Power Tube Department Regional Office. General Electric Company, Camera Tube Section, Building 267, Schenectady 5, New York.

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CATHODE RAY TUBE DEPARTMENT

GENERAL  ELECTRIC

Direct Energy Conversion

(Continued from page 43)

on solar cells is being directed toward increased efficiency by growing more perfect crystals and by experimenting with different materials such as gallium arsenide and cadmium sulfide.

Fuel Cells

For high efficiency, the fuel cell, which dates back to 1802 and Sir Humphrey Davy, is the most promising device. Unlike the thermoelectric and the thermionic generators, the fuel cell is not a heat engine—a device that takes in heat at high temperatures and releases it at a lower temperature, converting the net difference into some other form of energy, such as electricity—or mechanical motion, as in the case of the automobile engine.

Heat engines are limited to what is known as the Carnot efficiency. This efficiency, worked out early in the nineteenth century by the French physicist Sadi Carnot, is the difference between the input and output temperatures divided by the input temperature. (In the formula, temperatures are calculated in degrees Kelvin, or degrees above absolute zero, which is minus 460°F or minus 273°C.) Actually, no heat engine obtains even the Carnot efficiency, because of energy losses in heat, friction, and so forth. The highest efficiency obtained today by the newest and largest central power stations is in the neighborhood of 42 per cent.

Being a battery, the fuel cell is limited in its efficiency only by chemical reaction principles, in which two chemicals are fed into a cell where they react and produce both an electrical charge and a chemical byproduct. Theoretically, a fuel cell could be 100 percent efficient. An efficiency of 60 to 80 per cent, however, seems a reasonable and practical goal.

Unlike a storage battery, a fuel cell does not have to be recharged; it generates electricity as long as a fuel (hydrogen, propane, etc.) and air (or oxygen) are pumped into it. In the simplest form of fuel cell, the Hydrox cell, hydrogen and oxygen gas are continuously fed through porous carbon rods (electrodes) and react in an electrolyte, such as potassium hydroxide solution, to form electricity and water. Such cells have operated continuously for five years at low output levels; they develop problems, however, as output levels are increased.

Dozens of variations of fuel cells exist. One designed by Union Carbide works on hydrogen and air at

room temperatures and stimulates the chemical reaction by catalysts embedded in the carbon electrodes. Cells of this type have run continuously for two years in the laboratory and have been tested in the Army's "silent sentry" portable radar.

General Electric has developed a 30-pound power pack that uses 30 fuel cells and can produce 200 watts of 24-volt d.c. for 14 hours. It is recharged by replacing a fuel unit about the size of a beer can, which contains a metal hydride, a compound that gives off a steady stream of hydrogen when moistened. Both the Marines and the Army Signal Corps are interested in this power pack.

In still another development, the M. W. Kellogg Company is working on a prototype power plant for the Navy which uses an amalgam of sodium in mercury and oxygen (from water) to produce electricity. Early prototypes of this cell produced 75 kilowatts, with an efficiency of 60 per cent. Each cell develops twice the voltage of the Hydrox cell and weighs only 1/30 as much as a lead-acid storage battery with an equivalent power output.

Thermoelectricity

The direct conversion process which is receiving most attention at the present time is thermoelectricity. In mid-January this year, the Department of Defense and seven technical societies jointly sponsored a Symposium on Thermoelectric Energy Conversion in Dallas. This meeting attracted an attendance of 600 physicists, engineers and research directors, who shared information on their problems and accomplishments. Significantly, two of the eight technical sessions dealt with "device construction and performance." Significantly, too, two sessions were needed to consider "synthesis and evaluation of materials."

Thermoelectricity, like the other direct conversion processes, is a very old technique. It makes use of two principles discovered early in the nineteenth century. As early as 1821, the German physicist Thomas Johann Seebeck found that he could produce a feeble current if he heated a joint between two dissimilar metals or minerals. This so-called Seebeck effect led to the invention of the thermocouple, widely used to measure temperature. In 1834, the French physicist Jean Charles Peltier found that when a current was passed through a junction between two dissimilar metals, heat was liberated when the current was in one direction

and absorbed when the current was in the other direction. This is the so-called Peltier effect, utilized in the heat pump. Thermoelectric air conditioning and refrigeration for nuclear-powered submarines and manned spacecraft make use of the Peltier principle.

The physics of thermoelectricity is now reasonably well understood. In theory, efficiencies as high as 35 to 40 per cent appear reasonable. To accomplish this, however, the materials—semiconductors—used in the thermoelectric couples, as they are called, must have precisely the optimum combination of electrical properties and low thermal conductivity. This involves a compromise, as do so many engineering achievements.

A further complication in the case of thermoelectric materials is the fact that for any given material the best compromise of properties will exist for only a small temperature range. Since a thermoelectric generator is a heat engine, its efficiency increases with larger temperature differences, as the Carnot formula indicates. To operate over a wide temperature range, therefore, a thermoelectric generator requires a number of materials each efficient in its small temperature region. These several materials can be put in series, but the development problem is difficult—and expensive.

Six different thermoelectric materials were used in the five-kilowatt thermoelectric generator completed for the Navy by Westinghouse in May 1960, which operates with a temperature distribution ranging from 625° C to about 20° C. This generator is composed of two 2½-kilowatt units or subgenerators, each resembling a hollow cylinder about 30 inches in diameter and 30 inches high. Thermoelectric modules, each containing a number of P-N thermoelectric couples form the walls of the cylinder and are arranged around a kerosene burner. Heat from the burner is distributed to the hot sides of the thermoelectric couples; the outside, or cold side, of each module is water-cooled. A portion of the heat passing through the modules is converted to electricity by the thermoelectric material. The modules can be arranged electrically to give a wide range of output voltages and currents. These combinations range from 10 volts at 500 amperes to 120 volts at about 42 amperes.

Over-all efficiency of this fuel-fired system is about 5 per cent, and the present weight is about 65 pounds per kilowatt. However, the unit rep-

(Continued on page 91)



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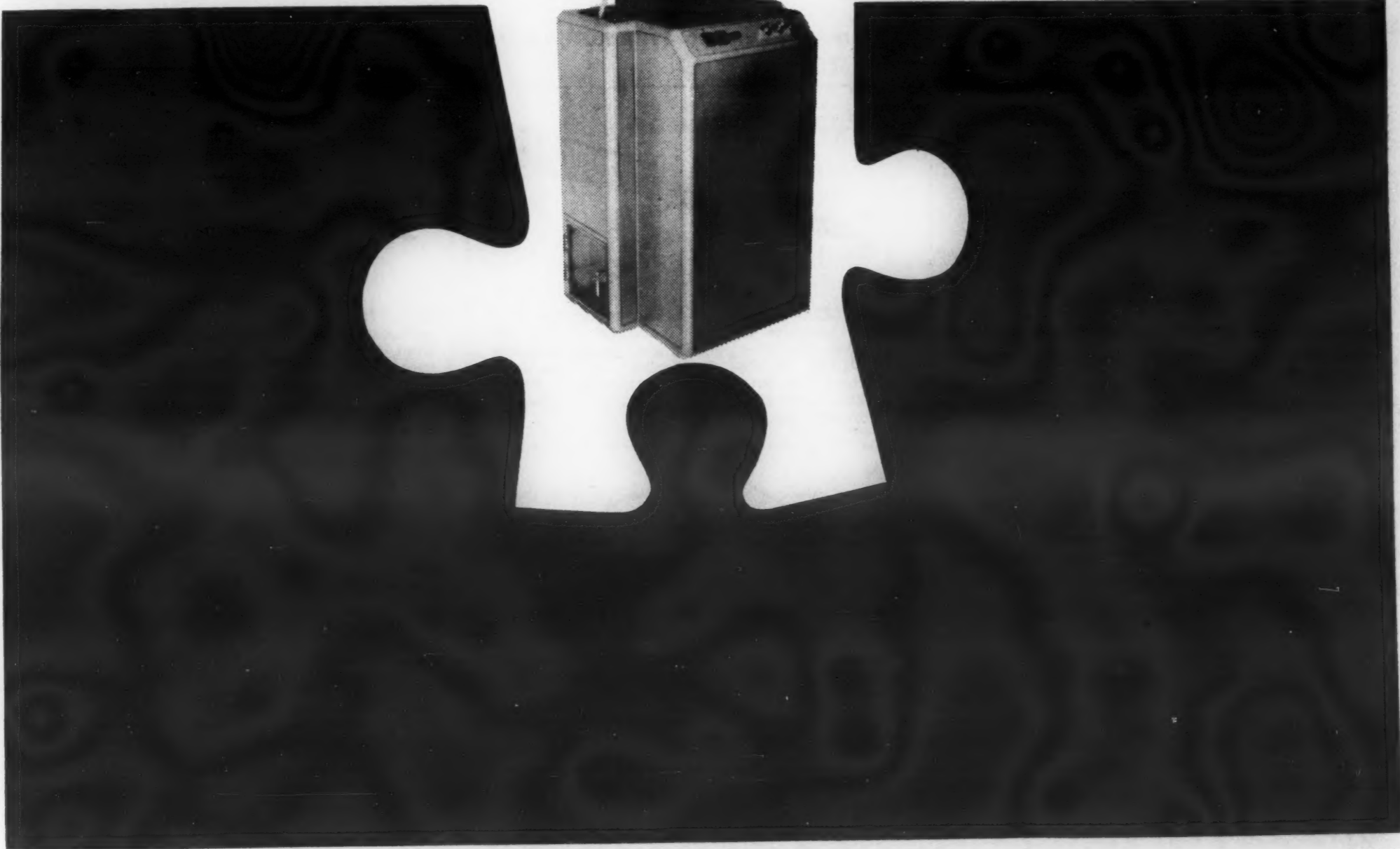
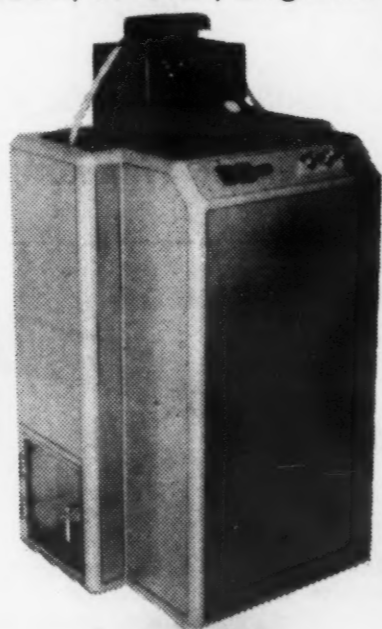
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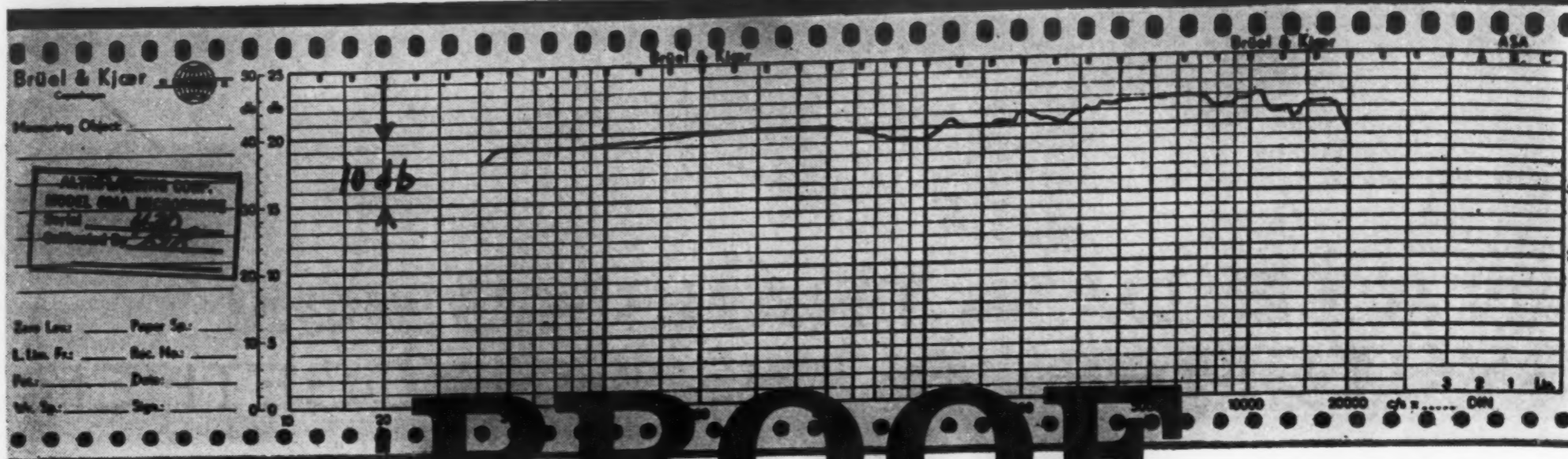
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ALTEC 682A—\$49.50 net—Featuring uniform frequency response from 45 to 20,000 cycles, the 682A Omnidirectional Microphone incorporates the new ALTEC "Golden Diaphragm" and exclusive sintered bronze filter. Output impedances of 30/50, 150/250, and 20,000 ohms easily selected in microphone plug.



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Complete line of accessories includes: desk and floor stands, switches, wall mounts, boom and shock mounts.

Direct Energy Conversion (Continued from page 88)

resents encouraging progress when compared with the first Westinghouse thermoelectric generators developed in 1958. Power output has increased from 3 watts to 5,000 watts; efficiency has increased by a factor of 12; watts per pound has increased by a factor of 165; and power from individual couples has increased by a factor of 60. One design for a space thermoelectric power supply indicates the possibility of a system of 5 pounds per kilowatt.

The Navy is also interested in a line of portable thermoelectric generators to meet various requirements in the field. Both Minnesota Mining and Manufacturing and Westinghouse are working on the development of a 500-watt, gasoline-fired thermoelectric generator to provide a nominal 28 volts d-c output and to be capable of being carried on a standard Marine back pack. Weight, accordingly, is to be 35 pounds or less.

End of Part I. Part II will appear next month.

IRE Show Highlights (Continued from page 83)

been possible only in theory in the field of semiconductor technology." In the epitaxial process, thin slabs of germanium or silicon are placed in a vapor containing a compound of the same material. When heated, the gaseous compound decomposes and deposits a new-growth extension on the original crystal.

An advanced study program at Lockheed's Missiles and Space Division has produced unfurlable antennas for space vehicle application. The pressure-erected models are typically fabricated of a Mylar-aluminum foil—Mylar laminate .0015 inches thick, and designed to be carried on the launched vehicle as a small furled package and to be erected automatically in space. An 8-foot log periodic is one type of unfurlable antenna. It folds compactly into a package of approximately $\frac{1}{3}$ cubic foot and weighs only 12 ounces. A pressure of about 6 psi is sufficient to inflate the tube; the inflated members are nearly perfect cylinders, self-supporting after relief of internal pressure. Design parameters provide operation over a frequency range of 70 to 700 mc. E-plane and H-plane patterns are similar and have beamwidths of about 74 degrees. Testing had demonstrated good performance in both radiation and impedance factors.

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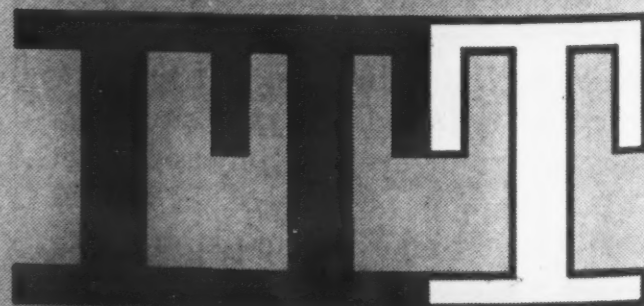
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American Radio Relay League, The
American Telephone & Telegraph Co.
Amphenol/Borg Electronics Corp.
Anaconda Wire & Cable Co.
Andrew Corp.
Anso Division, General Aniline & Film Corp.
Arnold Engineering Co., The
Associated Electrical Industries Ltd.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co. Ltd.
Autonetics, Division of North American Aviation, Inc.
Barry Controls Inc.
Bell Telephone Company of Pennsylvania, The
Bell Telephone Laboratories Inc.
Bendix Radio Division, The Bendix Corp.
Bendix Systems Division, The Bendix Corp.
Bliley Electric Co.
Bruno-New York Industries Corp.
Budd Electronics, Inc.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co., The
Cincinnati & Suburban Bell Tel. Co., The
Collins Radio Co.
Comptometer Corp.
Contraves Italiana S.p.A.
Convair/Pomona, Convair Division of General Dynamics Corp.
William C. Copp & Associates
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
A. C. Cossor Ltd.
Craig Systems, Inc.
Decca Navigator Co. Ltd.
Delco Radio Division, General Motors Corp.
Developmental Engineering Corp.
Diamond State Telephone Co., The
Dictaphone Corp.

DuKane Corp.
Du Mont, Allen B., Laboratories, Div. of Fairchild Camera & Instrument Corp.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
General Dynamics/Electronics, Division of General Dynamics Corp.
General Telephone & Electronics Corp.
Gilfillan Bros. Inc.
GP Engineering Services, Inc.
Gray Manufacturing Co., The
Hallamore Electronics Co.
Hallcrafters Co., The
Haloid Xerox Inc.
Hazeltime Electronics Division, Hazeltime Corp.
Heinemann Electric Co.
Hoffman Electronics Corp., Military Products Div.
Hogan Faximile Corp.
Hughes Aircraft Co.
I. D. Precision Components Corp.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co., Inc.
Ingersoll Products, Div. of Borg-Warner Corp.
Institute of Radio Engineers
Instruments for Industry, Inc.
International Business Machines Corp.
International Resistance Co.
International Standard Engineering, Inc.
Jansky & Bailey, a Division of Atlantic Research Corp.
Jerrold Electronics Corp.
Kleinschmidt, Division of Smith-Corona Marchant Inc.
Laboratory for Electronics, Inc.
Leich Sales Corp.
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Materiel Telephonique, Le
Maxson Electronics Corp., The
McCoy Electronics Co.
Melpar, Inc.
Michigan Bell Telephone Co.
MITE Corp. (formerly Teleprinter Corp.)
Montgomery Co., The
Motorola Inc.
Mountain States Telephone & Telegraph Co., The
Mullard Ltd.
Mycalex Corporation of America
National Co., Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
North Electric Co.
Northrop Corporation
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co., The

Pacific Telephone & Telegraph Co., The
Packard-Bell Electronics Corp.
Page Communications Engineers, Inc.
Pan American World Airways, Inc.
Paraplegics Manufacturing Co., Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co. Ltd., The
Prodelin Inc.
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Singer Manufacturing Co., The
Military Products Division
Society of Motion Picture & Television Engineers
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co., The
Southwestern Bell Telephone Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Sprague Electric Co.
Stackpole Carbon Co.
Standard Electronics Co.
Standard Telephones & Cables Ltd.
Stanford Research Institute
Stewart-Warner Electronics
Surprenant Mfg. Co.
Sylvania Electric Products Inc.
Technical Materiel Corp., The
Telectro Industries Corp.
Telephonics Corp.
Telerad Division, The Lionel Corp.
Teletype Corp.
Texas Instruments Incorporated
T.M.C. (Canada) Ltd.
Tung-Sol Electric Inc.
Union Carbide Corp.
United Telephone Co. of Missouri
United Transformer Corp.
Varian Associates
Vitro Electronics, Division of Vitro Corporation of America
Waterman Products Co., Inc.
Webcor, Inc., Electronics Division
West Coast Telephone Co.
Western Union Telegraph Co., The
Westinghouse Electric Corp.
Westrex Corp., a Division of Litton Industries, Inc.
Wheelock Signals, Inc.
Wilcox Electric Co., Inc.
Wisconsin Telephone Co.
Wollensak Optical Co.
Zenith Radio Corp.

Association affairs

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CHAPTERS AT LARGE

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Chapter News

REGION A

New York

Chapter President Glenn Montgomery presented guest speaker Dr. Charles E. Duke at the March 29 meeting held at the Belmont Plaza Hotel. Dr. Duke, vice president, Research and Development, HRB-Singer Company, spoke on Infrared Mapping Systems.

Limited only by the security aspect of infrared developments Dr. Duke's talk was supplemented by color charts and pictures illustrating various warm-body effects on infrared detection and recording equipment.

He told the audience of the amazing accuracy of such mapping systems explaining the definition and detail of these techniques and comparing them with visual and radar procedures. He also reviewed commercial possibilities of such equipment.

Underwater applications of infrared detection techniques were reviewed by Dr. Duke indicating this to be another space media in which future possibilities exist.

AFCEA vice president Rear Admiral Frank Virden, USN, Director of Naval Communications, was guest speaker at the April 26 meeting.

Lexington-Concord

The March 14 meeting was held at the Carriage House with 156 members and guests attending. Guest speaker was Professor Walter A. Rosenblith, head of Communications Sciences at MIT. He gave a talk on cybernetics, relating how today's computer environment is dependent upon the human control system.

Professor Rosenblith further discussed how much man has increased the functional processes of the mind over the last hundred years and what the capabilities of a man's mind might be one hundred years from now.

During the business meeting, Howard Dean, Marquart Corporation, presented the list of nominees for office and the approved chapter By-Laws. George Twigg, Raytheon Company, announced that General McCormick, vice president, MIT, would be the guest speaker at the April meeting. Senator Leverett Saltonstall, senior senator, Massachusetts, is guest speaker for the May meeting. The chapter will have an AFCEA "Golf Day" in June.

Syracuse

A dinner meeting was held at the Sheraton Syracuse Inn on March 8. Brigadier General D. P. Gibbs, deputy chief of staff, Communications and Electronics, North American Air Defense Command was guest speaker.

General Gibbs spoke on "NORAD—Communications and Electronics." He told the 96 members and guest attending of the scope of the defense organi-

zation and the planning that was involved to give us as much advanced warning as possible.

At the conclusion of his talk a film "Seconds for Survival," put out by the American Telephone and Telegraph Company, was shown.

REGION B1

Washington

Guest speaker at the March 2 luncheon meeting was John H. Rubel, deputy director, Defense Research and Engineering, Office of the Secretary of Defense. The meeting was held at the Grand Ballroom, Willard Hotel.

Mr. Rubel spoke on "Major Trends in Defense R & D," basing it on his experience in both industry and the military.

The April 5 meeting, also held at the Willard Hotel, featured guest speaker Major General J. F. Whisenand, USAF, Deputy Chief of Staff, Plans, ARDC. His subject was "Planning Factors in the Design of 'L' Systems." Recent experience in the Joint Chiefs of Staff and as DCS Plans, Headquarters ARDC, enabled him to discuss present and future advanced USAF Command and Control systems responsive to the aerospace era.

REGION B2

Dayton-Wright

The featured speaker at the March 15 meeting was A. A. Koepfer, chief, Reconnaissance Data Reduction Branch, Wright Air Development Division. One hundred members and guests attended the dinner meeting held at the Officers Club, Wright-Patterson Air Force Base.

Special guests were Colonel and Mrs. A. L. Wallace, Jr. (director, Advanced Systems Technology, WADD), and Colonel and Mrs. T. J. Commins (chief, Avionics Division, Directorate of Advanced Systems Tech., WADD).

Mr. Koepfer spoke on "Photography in Military Reconnaissance." He reviewed the advancements in photography, as applied to the reconnaissance mission, from 1942 to the present. He portrayed the outstanding advancements in this area using slides and film, some of which were in 3D.

The April 27 chapter meeting was held at the Dayton Air Force Depot, with the Wright Brothers chapter of the Armed Forces Management Association co-host.

Lexington

Twenty members and guests met February 24 at the Officers Club, Lexington Signal Depot, to discuss reactivating the chapter. A dinner meeting was planned for March 13 at which officers were elected. Those elected are: president, Colonel Henry L. Morris, University of Kentucky; executive vice president, Michael Keller, General

Telephone Company of Kentucky; vice president, William G. Stacy, Lexington Signal Depot; secretary, Harold G. Flanary, U. S. Public Health Service Hospital; treasurer, Tom R. Smith, Kentucky Utilities Company.

The following committees were appointed: executive committee, H. J. Huether, Jr., Colonel Charles Phipps, Raymond Soard, Charles Morrison; membership, Waddy Neubauer, Raymond Soard, James Sherrard; publicity, Arthur Boyd, Jim Mellon, Arrangements, CWO-4 Alton Philbrick, Harold G. Flanary; program, Michael Keller, H. J. Huether, Jr., Colonel Charles Phipps.

Guest speaker at the meeting was Dr. Bernd Ross, Wesson Metals Company. His topic was semi-conductors and he described the materials which are used in making semi-conductor devices and explained the characteristics of the negative and positive materials.

Pittsburgh

Members and guests of the chapter toured the Master Missile Site, Oakdale, Penna., on March 23. Master Missile is the successor to Nike and the backbone of the Pittsburgh Defense System.

REGION C

Augusta-Ft. Gordon

Tele-processing and communications systems were discussed at the March meeting. Dr. Joseph J. Farley, manager of tele-processing systems for International Business Machines Federal Systems Division, told of his company's developments in that field. The meeting was held in the Fort Gordon NCO Club.

Dr. Farley, currently responsible for IBM's high-speed magnetic tapes and data collection and data gathering developments, was the man responsible for developing specifications on the communications system for all meteorological tests during the International Geophysical Year.

Cape Canaveral

Lieutenant Colonel James W. Kelley, chapter president, conducted a short business meeting after the luncheon held March 23 at the Officers Club, Patrick AFB. He reminded the 23 members and guests present of the April 20 luncheon meeting and the April 27 Joint Council meeting.

On May 18 an evening meeting with the ladies present will be held at the Officers Club, Patrick AFB. At this meeting Dr. R. A. Ibison will present an illustrated lecture on the Space Travel Simulator developed by Electronic Communications, Inc. of St. Petersburg, Fla. October 3, 4 and 5 have been announced as the dates for the symposium to be sponsored by the chapter.

Gulf Coast

One hundred and nine members and guests attended a dinner meeting March 6 held at the Trade Winds Motel, Biloxi, Mississippi. Major James Gledhill, vice president, programs, gave an overall view of plans for future programs and introduced the guests of honor and speaker Keith Mattison.

Mr. Mattison, manager, Program Planning Defense Systems Department, General Electric Company, Syracuse, New York, spoke on "The Programs Confronting Industry in Coping with Future Military Systems." He emphasized the importance of creativity and innovation on the part of industry in developing solutions to military systems problems.

Using slides, he illustrated some examples of innovations. Among these were: (1) thermoplastic recording of visual images; (2) application of superconductivity principles; and (3) high intensity presentation of 3-dimensional electronic sweeps. Mr. Mattison was accompanied by W. S. Henry, manager of the Huntsville District of General Electric Defense Electronics.

Louisiana

A dinner meeting was held March 29 at Camp Leroy Johnson, Commissioned Officers Mess. Mr. C. C. "Bud" Walther, business and civic leader, who has toured European countries on several occasions, presented his impressions in a talk entitled "Those Russians."

Mr. Walther is a past president chapter president, past president of the New Orleans Chamber of Commerce and president of the Foreign Policy Association of New Orleans.

Northwest Florida

The chapter has elected the following new officers: president, Colonel Sterling K. Briggs; secretary-treasurer, Major Norman E. Zielinski; 1st vice president, Timothy R. Long; 2nd vice president, John M. Fain; 3rd vice president, Captain William O. White.

REGION D

South Texas

A dinner meeting was held March 15 at the Fort Sam Houston Open Mess. Guest speaker was T. E. Smith of Texas Instruments, Inc., who is manager of design and development in the Missiles Department.

Mr. Smith's subject was "Major Advances in Microwave Electronics." He discussed trends in microelectronics, miniaturized components, semiconductor networks, molecular electronics and the future potential of these trends. Models and films were used to illustrate the talk.

REGION E

Greater Detroit

The Burroughs Corporation hosted the March 22 meeting which was held at their manufacturing branch at Ply-

mouth, Michigan. Twenty-nine members and guests toured the branch following dinner.

This is one of Burroughs large manufacturing units producing electronic business machines currently used by modern business organizations.

Scott-St. Louis

A dinner meeting was held March 10 at Augustine's Restaurant with 74 members and guests attending. Special guests at the meeting were Brigadier General and Mrs. Norman L. Peterson and Major General and Mrs. Daniel C. Doubleday.

The program and speaker for the evening were introduced by chapter secretary Allan Eisenmayer. Guest speaker Brigadier General Norman L. Peterson, USAF, Commander, Air Weather Service (MATS), Scott Air Force Base, Ill., gave an illustrated talk on "Communications Requirements for Weather Satellites." As a special attraction a full scale model of the weather satellite Tiros II was on display, courtesy of General Peterson.

The following officers have been elected for 1961-62: president, Colonel C. W. Evans, USA (Ret.), Southwestern Bell Telephone Co.; vice presidents, Lieutenant Colonel Robert M. Brewer, USAF, Headquarters, AACS, and Commander George W. Laidlaw, USNR, American Telephone and Telegraph Co.; secretary, Allan L. Eisenmayer, Base Communications, Scott AFB; treasurer, Kenneth H. Norris, Headquarters, MATS.

Directors for a two year term are: Colonel David W. Baugher, Missouri Air National Guard; Louis E. Dechant, Dechant Electrical Service; Rear Admiral Robert E. Melling, USN (Ret.); B. R. Robards, Southwestern Bell Telephone Co.; Clifford G. Wassall, Southwestern Bell Telephone Co. Filling a one year vacancy as director is Lieutenant Colonel Joe P. Miller, USAF, Headquarters AACS.

The April 7 meeting featured guest speaker Henri Hodara, associate director for Space Communications, Research and Development Department, The Hallicrafters Company, Chicago, Ill. He presented an illustrated talk on "Putting Satellites to Work in Communications."

REGION F

Greater Los Angeles

A dinner and ladies' night were held March 15 at the Hilton Hotel, Golden Room, with 113 members and guests attending.

Guest speaker was chapter director L. D. Callahan, vice president, Gilfillan Bros. Inc. He told of his recent tour of the European NATO countries, comparing the amazing progress West Berlin has made economically with the situation that still exists in East Berlin. This was his first visit since the Berlin Air Lift. He humorously described the Pre-Lenten Fasching (the German version of the Mardi Gras).

Mr. Callahan also brought members and guests up-to-date on Ground Approach Control Equipment, which was engineered and developed by Gilfillan Bros. Inc. He said it took six years and 10 million dollars to bring it from a 22 ton monster to a 950 pound electronic marvel with pre-recorded voice directions to bring the pilot and aircraft in through zero-zero weather.

Chapter president John W. Atwood appointed the following to serve on the nominating committee: John W. Inwood, chairman, L. D. Callahan, C. A. LaHar, Loyd C. Sigmon.

San Diego

The January meeting featured Dr. John C. Webster head of Auditory Detection and Communications Section at the Navy Electronics Laboratory. He presented observations and photographs of his recent studies and travels in England and Europe. The meeting was held at the Midway Chuck Wagon Restaurant with 40 members and guests attending.

S. L. Ackerman, program director, Electronics Products, Convair Astronautics, was the featured speaker at the February 23 meeting held at the Sands Hotel. Mr. Ackerman discussed activities of his firm in electronics and took the 70 members and guests on a tour of the Astronautics plant following dinner and the talk.

Largest meeting of the season was March 16 at the Honker Restaurant in La Jolla when 80 members and guests heard guest speaker Dr. Wade L. Fite, scientist-in-charge, Atomic Physics Laboratory, General Atomic, San Diego. He explained the workings of the nuclear reactor, policies and work in progress at General Atomic and supervised a tour of General Atomic facilities and plant following the dinner meeting.

The April dinner meeting featured a presentation by Captain Burl L. Bailey, USN, commanding officer, U. S. Naval Air Station, Miramar. The evening also included a tour of the jet air base.

Seattle

The March 8 dinner meeting was held at the Benjamin Franklin Hotel with 44 members and guests attending. Special guests were: Commander R. L. Lowe, DCO, 13th Naval District, Navy Communications, Seattle, Washington; Captain Richard Quantz, chief of Communications, Washington State Patrol; L. F. McAdams, Air Defense Command, Colorado Springs, Colorado. Mr. McAdams is a member of the Rocky Mountain chapter.

Through the courtesy of chapter president Roy Pace, a unique tape recording was presented based on the detailed questioning of U. S. soldiers who were captured in Korea and underwent brainwashing at the hands of Chinese Communists. The questioning was handled by Major William E. Mayer, a psychiatrist who has spent a number of years specializing in the study of brainwashing.

EUROPEAN REGION

Paris

The chapter held a dinner meeting at the new UNESCO Building on March 21 with 73 members and guests present. The guest of honor was George Gosche, chief, Missiles System Division, Paris Office, Lockheed Aircraft Corporation. Mr. Gosche represented Admiral Vossler, general manager of Lockheed's Paris office. Rear Admiral Theodore A. Torgerson, director, C & C Division, U. S. European Command, presides over the meeting.

Following dinner Admiral Torgerson introduced Brigadier General Kenneth F. Zitzman, USA (Ret.), and announced his recent appointment as AFCEA regional vice president, European Region. In addition, General Zitzman was presented a Certificate of Group Membership for International Standard Engineering, Inc., of which he is executive vice president and managing director.

The program for the evening was a film on the Polaris missile program, for which Lockheed Aircraft Corp., is a prime contractor. The film was taken from Edward R. Murrow's "See It Now" television show.

PACIFIC REGION

Hawaii

A luncheon meeting was held March 15 at the Willows Restaurant with 87 members and guests attending. Special

guests were: E. B. Franklin, assistant regional manager, FAA; D. H. Long, Air Traffic Division, FAA; C. E. Aldrich, Facilities and Material Division, FAA.

At the short business meeting which followed the luncheon it was decided to contribute three awards (1st, 2nd and 3rd place) in the name of AFCEA to the Fourth Annual Hawaiian Science Fair which was held at Kaiser Dome March 24-26. The awards were given for the exhibits judged most meritorious in the communications, electronics and photographic field.

Mr. Franklin, Mr. Long and Mr. Aldrich spoke briefly about the mission, functions and equipment installed in the new Federal Aviation Agency's Air Traffic Control Center located within the crater of Diamond Head. The group took a tour of the new FAA Center.

Tokyo

On February 3 approximately 100 members and guests toured the Fleet Activities at Yokosuka and the USS Coral Sea. In the evening a dinner was held at the Yokosuka Beach Club.

Seventy-five members and guests met at the American Club of Tokyo on March 10. Following dinner, informal speeches were given by Dr. Gunji Hosono, Miss Haruko Hosono and Lieutenant Commander John W. McCord, Transit Project Officer, Pacific Missile Range.

Dr. Hosono and his daughter Haruko, the only individuals from Japan invited

to the Inauguration as personal guests of President Kennedy, spoke on their impressions of the trip and of President Kennedy.

Commander McCord explained the general purpose and structure of the Pacific Missile Range.

The annual awards banquet was held May 3 at the Washington Heights Officers Club. Recognition was extended to outstanding Japanese contributors in civil and military communications and electronics.

CHAPTERS AT LARGE

San Juan

A business meeting and dinner were held March 16 at the Fort Brooke Officers Club. Twenty-four members and guests attended. Following the business meeting, Earl Dudley, formerly with Formento (Puerto Rico Industrial Development Company) and now technical consultant for the Commonwealth Department of Education, spoke to the group.

He spoke on his new position, saying that the training is planned on a college level, without college credit, and was designed to take the advance student and place him in a position of capability of handling engineering problems. He said that the present high school graduate, in Puerto Rico, is usually unable to pass the entrance examinations for college, principally due to the fact that he has an absolute lack of knowledge of math and related subjects.



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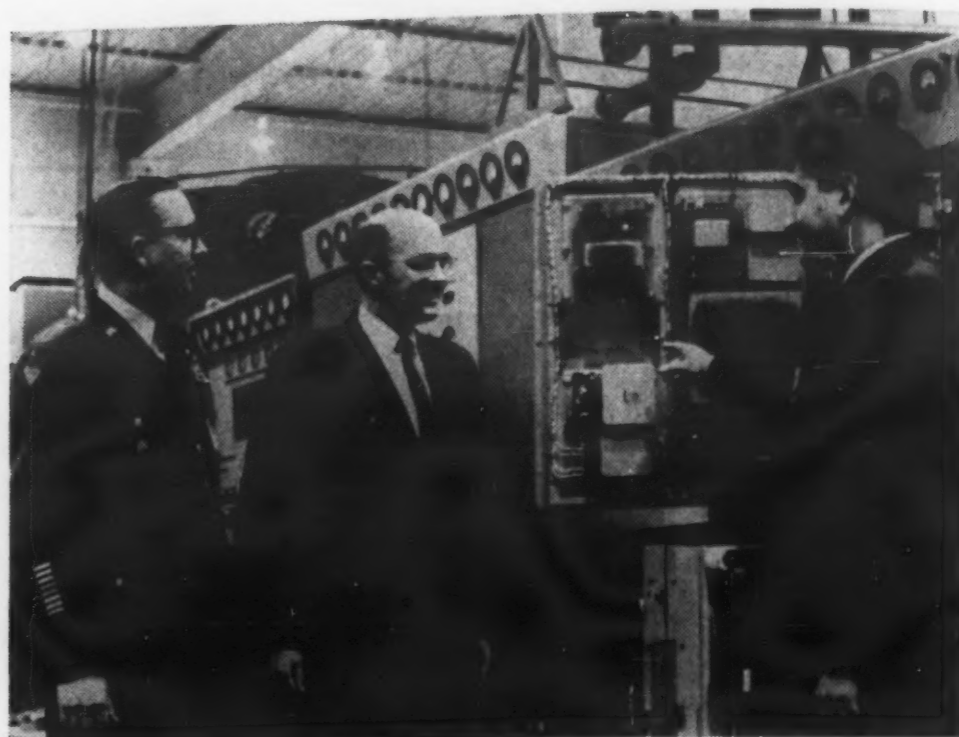
Augusta-Ft. Gordon—(photo left) At the March meeting: (L to R) chapter president, Col. T. J. Trainor; guest speaker, Dr. J. J. Farley, manager, Tele-processing Systems, IBM's Federal Systems Division; Col. S. A. Stricklen; O. S. Niehuss, chapter board of directors. (photo right) **San Diego**—Pictured at the March 16 meeting: (L to R) guest speaker Dr. W. L. Fite, General Atomics; Mrs. Beryl Bailey; Capt. Beryl Bailey, Miramar Naval Air Station; chapter president, Capt. J. H. Allen, USN.



New York—(photo left) Chapter vice president Frank Gunther, Radio Engineering Labs., (left) welcomes special guests at the March 29 meeting: (L to R) Col. P. A. Stanley; guest speaker Dr. C. R. Duke; Lt. Col. R. C. Koener; Capt. W. Finch, USN (Ret.). (photo right) **Fort Monmouth**—Pictured at the March dinner meeting are: (L to R) Brig. Gen. J. E. Heinrich, USAR (Ret.); Brig. Gen. C. M. Baer; chapter president, Dr. H. K. Ziegler; guest speaker Lt. Gen. A. G. Trudeau, Army Chief of Research and Development; Maj. Gen. W. D. Hamlin; Brig. Gen. W. M. Thames.



Greater Los Angeles—(photo left) Guest speaker at the March 15 meeting was L. D. Callahan, Gilfillan Bros. Inc., chapter director. At left is J. W. Atwood, chapter president. (photo right) **Tokyo**—(L to R) Dr. Gunji Hosono, chapter president H. Van Zandt, Miss Haruko Hosono and Capt. E. Knepper, USN, 2nd vice president, at the March 10 meeting held at the American Club of Tokyo.



Scott-St. Louis—(photo left) At the March 10 meeting guest speaker Brig. Gen. N. L. Peterson, USAF, (second from right) explains features of a full scale model of weather satellite Tiros II to: (L to R) Col. C. W. Evans, USA (Ret.), chapter vice president; Col. D. W. Baugher, chapter president; Maj. Gen. D. C. Doubleday, USAF, chapter director. (photo right) Syracuse—(L to R) Brig. Gen. D. P. Gibbs, guest speaker at the March 8 meeting. W. F. Squires, chapter vice president, and L. H. Lynn are shown inspecting Nike-Hercules radar equipment at the Syracuse Heavy Military Electronics Department of General Electric Co.



Santa Barbara—(photo left) Special guests at the February 10 meeting (back row, L to R) Peter Baum, Rolf Gehlhaar, Anne Booher, Steve King, Joe Sayovitz, Jr. Others pictured are: (front row, L to R) R. Redemske, Servomechanisms, Inc.; guest speaker Capt. W. Scarpino, USN (Ret.); chapter president, Adm. C. C. Ray, USN (Ret.); Lt. Col. H. H. Dillard, USAR (Ret.); Dr. J. J. Sayovitz. (photo right) Greater Detroit—One of the groups attending a tour of Burroughs Corp., Plymouth Manufacturing Plant, on March 22, being given an explanation of a small scale computer. (L to R) D. E. Stromback, J. C. Lindley, E. S. Lindberg, S. J. Guzowski, chapter treasurer J. H. White, C. L. Brady, P. J. Schafer, W. B. Snell, R. I. Vanderhoof, R. W. Fisher, chapter president J. I. Vanderhoof, R. E. Morrison, J. D. Clair, P. K. Harter.

Association News

Association Notes of Interest

AFCEA National President, Benjamin H. Oliver, Jr., vice president, Upstate New York Telephone Co., was guest speaker at the April 12 dinner meeting of the Syracuse chapter which was held at Carrier Corp. Mr. Oliver spoke on "The Role of AFCEA." Col. W. J. Baird, AFCEA General Manager, was a guest speaker at a luncheon meeting the chapter held on the same day at the Hotel Syracuse Country House. Mr. Oliver also spoke at the Cincinnati chapter meeting on April 26 and at the Dayton-Wright chapter meeting on April 27.

The Arizona chapter has announced that ten Arizona high school students have entered its statewide contest for scientific achievement in the fields of communication, electronics, optics and photography. The experiments and models will be displayed and judged at the Fort Huachuca Armed Forces

Day celebration on May 20. In addition to the exhibit the chapter will have a hospitality tent.

The Lexington-Concord Chapter is sponsoring the 1st Annual AFCEA Golf Tournament and Outing on June 15. Details, including the name and address of the person to be contacted, can be found on page 98.

Ray Meyers, regional vice president, reports that the 1961-62 edition of the AFCEA Ham Membership Directory has been published and mailed to those listed in the Directory. The second edition was due largely to the efforts of Price Swinney, W6UTB, and Mr. Meyers.

AFCEA Treasurer Assumes New Position

W. Earl Trantham, Jr., has been appointed manager of a new operations department of Hughes Aircraft Com-

pany's microwave tube division. He has served the Association for two years as treasurer.

I. D. Precision Components Corp. New Group Member

I. D. Precision Components Corporation has joined the Association as a group member. The company is in electro mechanical mechanisms used in the field of electronics. Walter A. Kirsch, sales manager, has been named as representative to the Association.

In addition to Mr. Kirsch, others named to membership are: Harvey S. Dinstman, president; Bernard Meyers, vice president; Joseph Dinstman, treasurer; Hyman Dinstman, secretary; Richard M. Meyers, assistant to the vice president; Michael Meyers, sales engineer; Edward C. Jones, plant manager; Siegfried M. DeBliech, chief engineer; Robert B. Feldman, associate engineer; William Fraser, quality control manager.



(Photo Left) RAdm. T. A. Torgerson (right) presents Brig. Gen. K. F. Zitzman, USA (Ret.), with a group membership certificate for International Standard Engineering, Inc. The presentation was made at the March 21 Paris chapter meeting. (Photo right) H. F. Jacobson (center) accepts the Pan American World Airways group member certificate, at the March meeting of the Arizona chapter, from Col. Otto Saar (left) and Lt. Col. C. D. Harding (right), chapter president. Mr. Jacobson is director, Electronic Environmental Test Facility, for Pan American.

Listing of new members of AFCEA who joined during the months of March and April will appear in June.

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NEWS ITEMS AND NEW PRODUCTS

To reduce Government costs and simplify procurement administration, Deputy Secretary of Defense Roswell Gilpatric has rescinded Department of Defense Directive No. 7800.6, dated November 1, 1957, which provided for withholding 20 percent of costs incurred by contractors performing certain categories of cost-reimbursement contracts until they had delivered end items or performed specified increments of work.

The effect of this cancellation is (1) to reinstitute the practice which prevailed prior to November 1957 of paying contractors in full for their incurred costs as they accrue in work on future contracts of this type; and (2) to authorize the Military Departments to pay present contractors the amounts currently deferred to the extent these contractors are willing to renegotiate their fee. It is estimated that some \$175 million of deferred payments to contractors could be accelerated if contractors avail themselves of this provision.

Criticism of the withholding policy centered around the fact that contractors were, in many instances, forced to borrow in order to fund the 20 percent of costs which the Government withheld. The interest charges on these loans were an added expense to the contractor and hence entered into determination of his fee, and ultimate cost to the Government.

The policy of withholding 20 percent of costs incurred on such cost-reimbursable contracts was originally based on the theory that in requiring the contractor to invest capital in inventories, services and work-in-process until delivery, he would have more incentive to strive for greater efficiency, economy and better management resulting in lower costs to the purchaser. With the adoption of the 1957 policy, one of the factors considered in arriving at an equitable fee was costs incurred by the contractor resulting from the deferred payment.

The policy of withholding applies to all cost-plus-fixed-fee contracts except: (a) those where the contractor received no fee or profit; (b) those with educational institutions or non-profit organizations; (c) those solely for the operation of Government-owned plants; or (d) contracts with small business which would, in the determination of the Secretary of the

military departments, effect undue hardship on the contractor's interest. In the application of the policy more than \$400 million was estimated to have been withheld from contractors at the time of initiation of this policy.

Expenditures for research and development in the Nation, estimated at \$12.4 billion in 1959, were equal to 2.6 percent of the gross national product for that year. During recent years this ratio has remained relatively constant, over 2 percent.

These data are included in a report released by the National Science Foundation which emphasizes that expenditures for R & D serve as one of the most productive stimulants to long-run economic growth. While R & D expenditures increased as a percentage of the gross national product from 1953 to 1959, the report notes the modest share they continued to represent in the total national effort.

Basic research expenditures represented only two-tenths of one percent of the gross national product in recent years. Since many R & D accomplishments derive ultimately from the basic research effort, the study suggests that it represents a relatively inexpensive means of accelerating economic growth.

The foundation study, "R & D and the Gross National Product," is reported in *Reviews of Data on R & D*, No. 26. Copies may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price is 10 cents per copy.

Japanese exports of electronic products to the United States during 1960 totaled \$94.0 million, a 24 percent increase over the \$75.6 million total of 1959, the Electronics Division, Business and Defense Services Administration, U.S. Department of Commerce has reported.

The value of exports of radio receivers in 1960, which accounted for 74 percent of the total shipments, registered a gain of 11 percent over 1959. Exports of radios with 3 or more transistors last year increased by 4 percent in quantity, but declined by 4 percent in value from the preceding year; exports of other radios increased appreciably.

Other products, showing substantial gains, were sound recorders and reproducers, radio-phonographs, speakers, receiving tubes and other electronic components. The 1960 exports of television receivers to the U. S. totaled 10 thousand valued at \$507 thousand.

Exports to the U. S. were equivalent to 48 percent of total Japanese exports of electronic products to the world in 1960 compared with 56 percent in 1959.

Assistant Secretary of Commerce for International Affairs Rowland Burnstan headed a group of Department of Commerce and State officials who participated in a Regional Conference of commercial officers of the U. S. Foreign Service at Hong Kong last month.

The meeting was held to advance the aims of the Administration's program to expand exports. The Conference brought together principal commercial officers from 22 U. S. Foreign Service posts in 16 countries of the Far East and South Asia and U. S. Government officials concerned with the program. An exchange of views and suggestions on how U. S. business can best be served in enlarging sales of American products in Far Eastern markets was the main theme of the Conference.

A pre-proposal conference for industrial firms interested in being considered as the systems contractor on the Saturn S-II stage was held at the Marshall Space Flight Center in Huntsville, Ala., last month.

Twenty firms were invited to participate in the first phase of a two-phase contractor proposal evaluation. At the first meeting, potential contractors were given general information on the S-II stage permitting them to determine whether they were interested in offering to do the work. Interested firms were given requests for initial proposals which were due at the Marshall Center on May 11. These proposals contain information on the firms' capabilities and past experience. From these proposals will be chosen a lesser number of firms who will be invited to submit detailed offers, including cost information based on the complete specifications given them.

The S-II program will be a major



James D. McLean (left), president of General Dynamics/Electronics, presents the 1960 General Dynamics / Electronics Award for Science and Technology to George A. Franco, manager of the Radio Communication Laboratory in General Dynamics/Electronics Research Division. Dr. N. A. Finkelstein (center) looks on. Mr. Franco developed a technique for high speed data transmission, exceptionally resistant to jamming, called DEFT (Dynamic Error Free Transmission).

undertaking—the largest rocket yet to be built totally within U. S. industry. Purpose of the two-phase evaluation is to reduce, in the first phase, the list of potential contractors to a limited number who possess demonstrated competence and capability, and to allow other contractors not in a competitive position to avoid the great expense of preparing detailed proposals.

The S-II stage is to be the second stage of the Saturn C-2 configuration. It will be powered by four J-2 liquid-hydrogen, liquid-oxygen engines, each developing 200,000 pounds of thrust for a stage thrust of 800,000 pounds. The S-11 will be about 21½ feet in diameter and about 74 feet in length.

The twenty firms invited to participate in the April meeting were: Avco Manufacturing Corp., Bell Aircraft Co., Bendix Aviation Corp., Boeing Airplane Co., Chance Vought Aircraft, Inc., Chrysler Corp., Convair, Douglas Aircraft Co., Firestone Tire and Rubber Co., General Electric Co., Hughes Aircraft Co., Lockheed Aircraft Co., Martin Co., McDonnell Aircraft Corp., North American Aviation, Inc., Northrop Corp., Raytheon Co., Sperry Rand Corp., United Aircraft Corp., and Western Electric Co. Basis of this selection is that each of these companies has had prime responsibility for a rocket system with length of 25 feet or greater.

The Electronic Industries Association, Small Business Committee, is pressing for Congressional action on legislation to indemnify defense manufacturers against uninsurable claims resulting from missile and rocket accidents.

Following a warning that electronic components makers could be

held liable for losses should a test rocket fall by accident into a heavily populated area, the committee resolved to seek support for legislation from the Small Business Administration and urged committee members to make individual appeals to their representatives in Congress.

A plea for backing for a bill sent to Congress recently by the Defense Department is to be made to the Small Business Administration by the committee chairman, C. J. Harrison, senior vice president of Rixon Electronics Inc.

NASA and Jet Propulsion Laboratory have announced reception of strong, clear radio signals reflected back to earth from Venus in a 70-million mile round trip taking about 6½ minutes. The first transmission was completed at 9:34 p.m. EST, March 10 at JPL's Goldstone Tracking Station, 50 miles north of Barstow, California.

Dr. Hugh Dryden, Deputy Administrator of NASA, said this is the first time such signals have been immediately detectable without elaborate analysis and processing.

Objective of the experiment is to determine whether Venus spins on its axis and the rotation speed; to determine the orientation of the planet's spin axis; to investigate the nature of the surface of Venus as determined by the reflectivity of its surface; and, to further define the measuring unit of the universe, the approximate 93-million mile Astronomical Unit. The exact length of the Unit, the mean distance from the earth to the sun, has not been defined to within about 10,000 miles.

Every 19 months Venus approaches to within about 26.2 million miles of earth compared to a maximum separation of 162 million miles. This

closest approach, known as the inferior conjunction, occurred this year on April 11. The present development of radio communication makes it impractical to attempt radio contact with Venus except during comparatively brief periods before and after inferior conjunction.

The transmitting antenna, located seven miles from the receiving antenna to minimize interference, sent a 2388 megacycle/second signal to Venus using about ten kilowatts of power. The signal was a conical beam only .4 of a degree in width. The signal sent March 10 traveled at the speed of light (186,000 mile/second) and took another 3¼ minutes to complete the trip and be detected by the Goldstone receiver.

The receiver used both a maser and a parametric amplifier. The ruby crystal of the maser amplifier was maintained at the temperature of liquid helium (-452°F, a few degrees above absolute zero), to reduce the receiver generated noise power to a very small quantity.

A cooperative program for the trans-Atlantic testing of experimental communication satellites provided and launched by the National Aeronautics and Space Administration has been announced jointly by agencies of the United States, England and France.

The British General Post Office and the French Center for Telecommunications Studies have agreed to provide ground stations in Europe for transmission of multi-channel telephone, telegraph and television signals using satellites to be launched by NASA during 1962 and 1963 in Projects Relay and Rebound. The stations will be equipped with advanced radio facilities having extremely accurate tracking and antenna pointing qualities and capable of conducting tests with active and passive satellites at high frequencies and low power. Surveys are currently being made to determine their locations.

Project Relay, a low altitude active repeater satellite programmed to be launched in 1962, will weigh less than 100 pounds. The spacecraft will contain instruments to detect radiation damage and other environmental effects on critical components as well as communication experiments.

Project Rebound is a follow-on of the first passive reflector communication satellite program, Echo. It proposes to place several rigidized in-

(Continued on page 107)



A strain gage transducer nears completion. It is made by Statham Instruments, Inc., Hato Rey, Puerto Rico.

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cal and electronic equipment. Seven others will open soon.

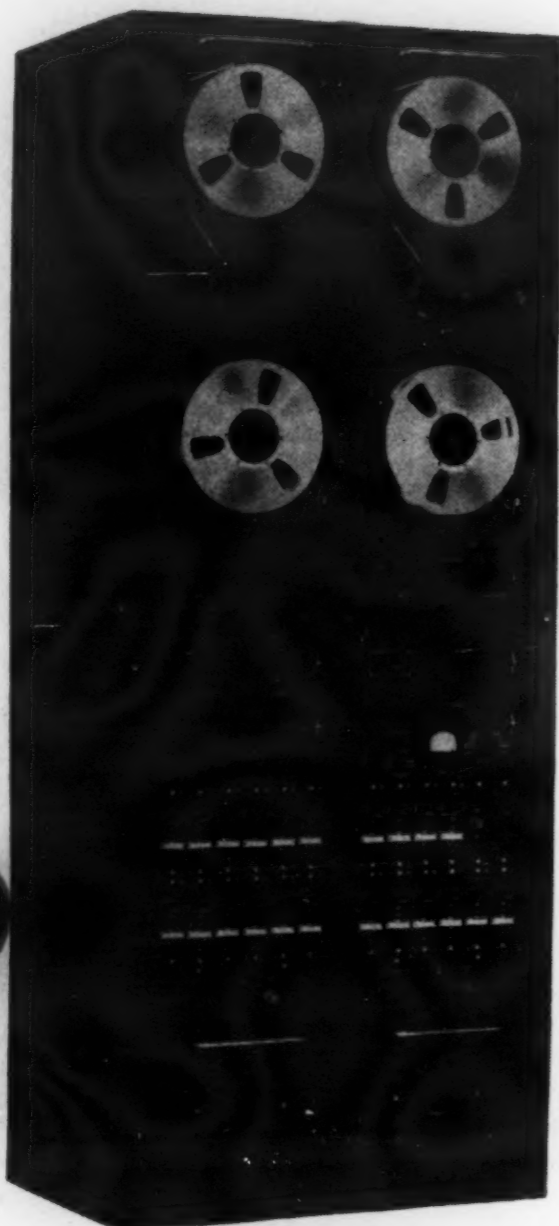
Most of the electrical and electronic products manufactured in Puerto Rico today require highly skilled assembly operations. Note the girl above. She is assembling a most delicate instrument. It measures blood pressure *inside* the heart.

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forming for U.S. industry. These workers are astonishingly clever with their hands. And quick to master intricate jobs.

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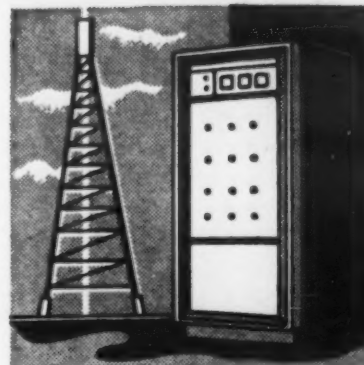
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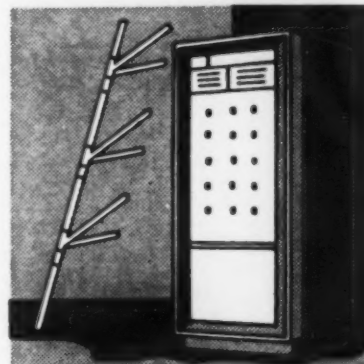
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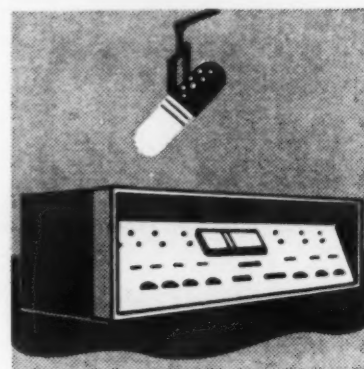
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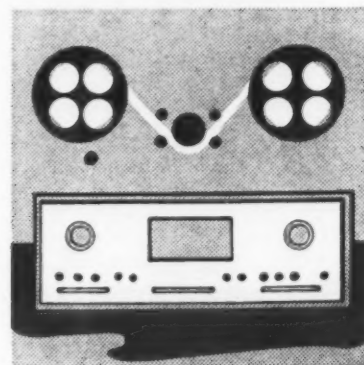
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flated spheres in orbit by using a single launch vehicle. The first launch to orbit three spheres is programmed during 1963.

The cooperating nations will welcome participation by other countries should they desire to provide additional ground facilities for the experiments.

Representatives of NASA and the French Comité des Recherches Spatiales in informal technical discussions last March affirmed a desire for cooperation in space science research of mutual interest.

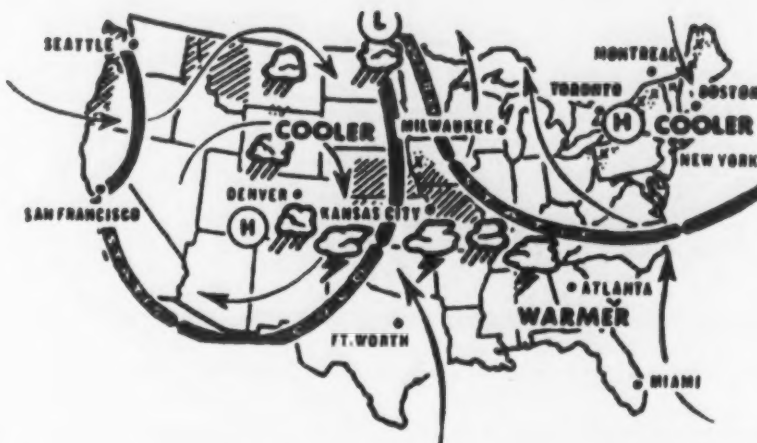
The two organizations plan the following initial steps: (1) The Comité expects to make detailed proposals for experiments in the VLF, auroral and airglow, and biological fields, with the expectation that these experiments will be prepared by the Comité and flown, as mutually agreed, in appropriate scientific sounding rockets by NASA; (2) Further arrangements are contemplated for the preparation of these experiments by the Comité for incorporation in satellites to be launched by NASA, assuming favorable results are obtained in rocket soundings as appropriate; (3) The two organizations will exchange information regarding the design, equipment and operation of a scientific sounding rocket launching site. Such exchanges will include technical visits as necessary; and, (4) As an initial step toward mutual exchanges of personnel for training and familiarization, NASA will accommodate in its space science centers technicians sponsored by the Comité as may be agreed.

Amateur radio operators of the northeastern U. S. wishing to compete in the nation-wide 12th Armed Forces Day amateur radio program to be conducted on Saturday, May 20, may receive time schedules and procedures by contacting Hq. First U. S. Army MARS (Military Affiliate Radio System) Director, Signal Section, Bldg. 550, Governors Island, New York 4, N. Y.

A message from the Secretary of Defense will be sent via shortwave in International Morse Code (CW code) at 25 wpm; and, by a radioteletypewriter (RATT) transmission at 60 wpm. A military-to-amateur transmitting and receiving test will be conducted for all holders of valid U. S. amateur radio station licenses. Headquarters radio stations of the Army, Navy and Air Force will operate on spot frequencies outside the amateur

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HI-POWER ELECTRONICS



Radar Transmitter FPS-35

**For the
security
of our
nation**

The AN/FPS-35 Radar Search Set is an integral part of America's security defense network. This massive sentinel stands in vital areas protecting the nation.

FXR is the designer and developer of the Line Modulator, the key block in the transmitter complex. High level engineering combined with complete precision facilities produced the answers to the unique problems encountered.

Solutions to the most exacting specifications are the foundation of FXR's service in High Power Electronics. The solution to your particular problem is but a phone call away. Just call and ask for an FXR applications engineer to discuss your needs.

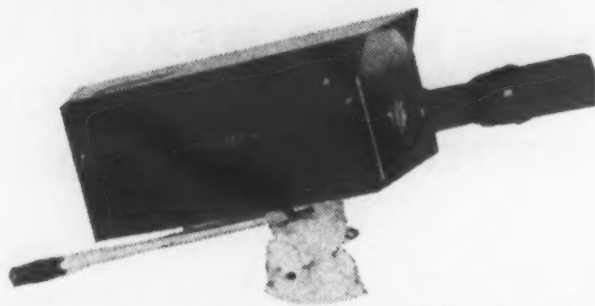


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**NEW! FOTO-VIDEO Broadcast Quality Image Orthicon
TV Camera, the V-600**

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See it at Foto-Video booth No. 277 at AFCEA, Shoreham Hotel, Washington, June 6-8. Also see the latest in Military TV Equipment engineered and manufactured by

FOTO-VIDEO Electronics, Inc.
Cedar Grove, N. J. CEnter 9-6100

At last we have a monthly publication presenting analyses and interpretations of latest developments in the military contract field . . . current subject of discussion . . . significant changes to Armed Services Procurement Regulation Revision No. 3, dated January 31, 1961 . . . complete detailed analysis and review.

"ADMINISTRATIVE AND ACCOUNTING GUIDE FOR DEFENSE CONTRACTS"

Edited by Paul M. Trueger with Department of Defense contracts for over 18 years and who specializes in accounting and administrative services to firms performing under Army, Navy and Air Force contracts. Author, "Accounting Guide For Defense Contracts," published by Commerce Clearing House, Inc.

The Guide is different from any other publication in its field. The Guide, with advantages of a staff immediately and extensively experienced in its field, carefully analyzes and interprets the significance of current developments to the reader. We are in position to present the current developments not as isolated events, but in terms of present experiences and their relationship, patterns and trends over the years. It is the identification, explanation and interpretation that makes the difference between news tidbits and meaningful, constructive information.

The Guide reports on, analyzes and interprets current developments by specialists in the field relating to Renegotiation, Termination, Defense Contract Awards, Defense Contract Pricing and Repricing, Defense Contract Administration, Decisions by Boards, Courts, etc.

Important to all defense contractors and subcontractors, firms interested in obtaining, administering and processing contracts and subcontracts, and to accountants and attorneys who are called upon to service such firms.

"ADMINISTRATIVE & ACCOUNTING GUIDE FOR DEFENSE CONTRACTS," 160 B'way, N. Y. 38

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- ☐ Please send sample copy of guide.

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bands and will establish radio contact with the amateur stations.

Awards will consist of special QSL (acknowledgment) cards from the services and Department of Defense certificates of merit. Completed message entries should be submitted by May 31 to the Armed Forces Day Contest, Room BE1000, the Pentagon, Washington 25, D. C.

The Industrial Management Center, a private educational institution, is offering a course in Capital Expenditure Analysis, June 11-16, at The Lake Placid Club, Lake Placid, New York. Theory and practical application of the latest investment analysis techniques will be discussed by educators and industrialists who specialize in this field. The course will offer step-by-step discussions of the uses and misuses of various methods of analysis including the pay-off period and MAPI approach.

The fee for the course is \$375 which includes tuition, books and supplies. For further information contact James R. Bright, Director, Industrial Management Center, 370 Concord Road, Weston, Massachusetts.

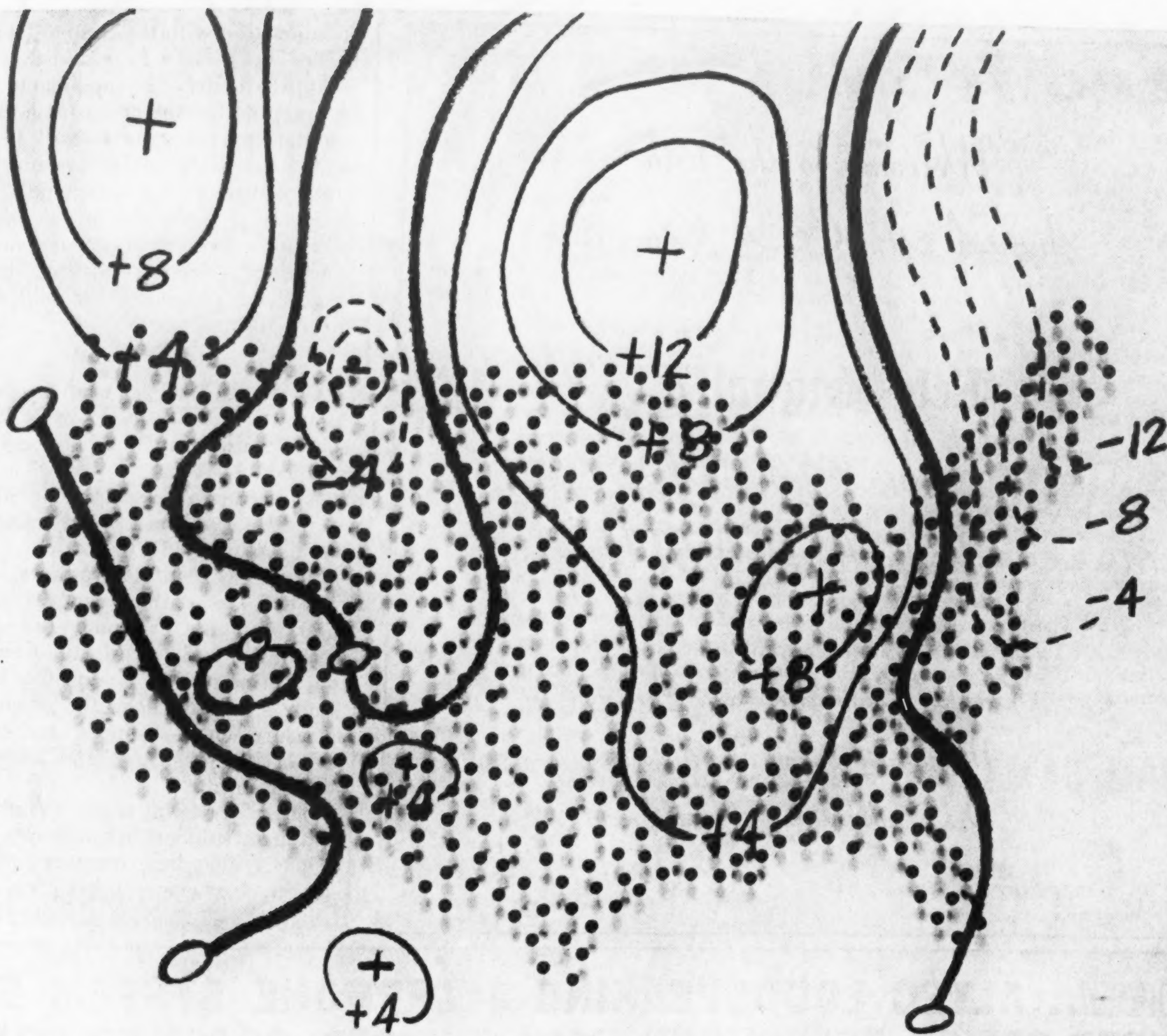
Worcester Polytechnic Institute will conduct a series of at least three, two-day fallout shelter design and evaluation workshops for architects and engineers before the end of June.

The college has signed a contract for the series with the Federal Government. The workshops are part of a nationwide series to be conducted by eight universities or colleges, one in each Office of Civil and Defense Mobilization Region. The Worcester Polytechnic Institute series is designated for Region One, which includes the New England states, New York, New Jersey, Puerto Rico and the Virgin Islands. All Regions will teach the fundamentals in design of shelter to protect against gamma radiation which would result from nuclear attack.

The first advanced course offering a master's degree in reliability engineering will begin this June at the Case Institute of Technology, Cleveland, Ohio, as part of the Air Force program to establish higher reliability standards. The Air Force is sponsoring the course.

An even more specifically designed curriculum prepared by the Institute is being reviewed at Air Research and Development Command Headquarters. When approved, this program will be carried out in close

(Continued on page 110)



Every 15 minutes, weatherfax maps are transmitted simultaneously to weather stations across the United States.

Western Union Facsimile Network sends weather maps 600 places...simultaneously

From the Weather Bureau in Washington, D. C., weather maps speed out in picture data form to 600 stations in 330 cities. This system serves the Weather Bureau, the Air Force, Army, Navy, Coast Guard, commercial airlines, public utilities and other nonmilitary subscribers.

The world's largest facsimile network—designed and engineered by Western Union for the Weather

Bureau—makes this mammoth task routine. Today, weather news goes coast to coast in minutes... *in writing*... no mistake about it!

Maps are received simultaneously at all network points. Result? All users know instantly of weather conditions in any part of the country *at precisely the same time*.

Eight times each day, from the U. S. Weather Bureau in Kansas City, Mo., special radar maps are

transmitted to these same subscribers.

Now, for any kind of weather, the nation is better able to predict in time, prepare with certainty... from data transmitted in exact, error-proof, written form.

WESTERN UNION

*... finds better ways
to speed it electronically.*

*Welcome to the 15th
Annual AFCEA Convention*

Tele-Signal Corp.
198 Miller Pl.
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*Creative Engineering and Precision
Manufacturers of Transistorized
Telegraph Terminal Equipment*

collaboration with the System Project Offices at ARCD's four divisions.

Approximately 20 applicants will be accepted for the new course. After graduation, participants will be assigned to ARDC major systems program offices at the command's four divisions. Applicants must have a bachelor's degree in science or engineering. Base education offices should be contacted for additional information.

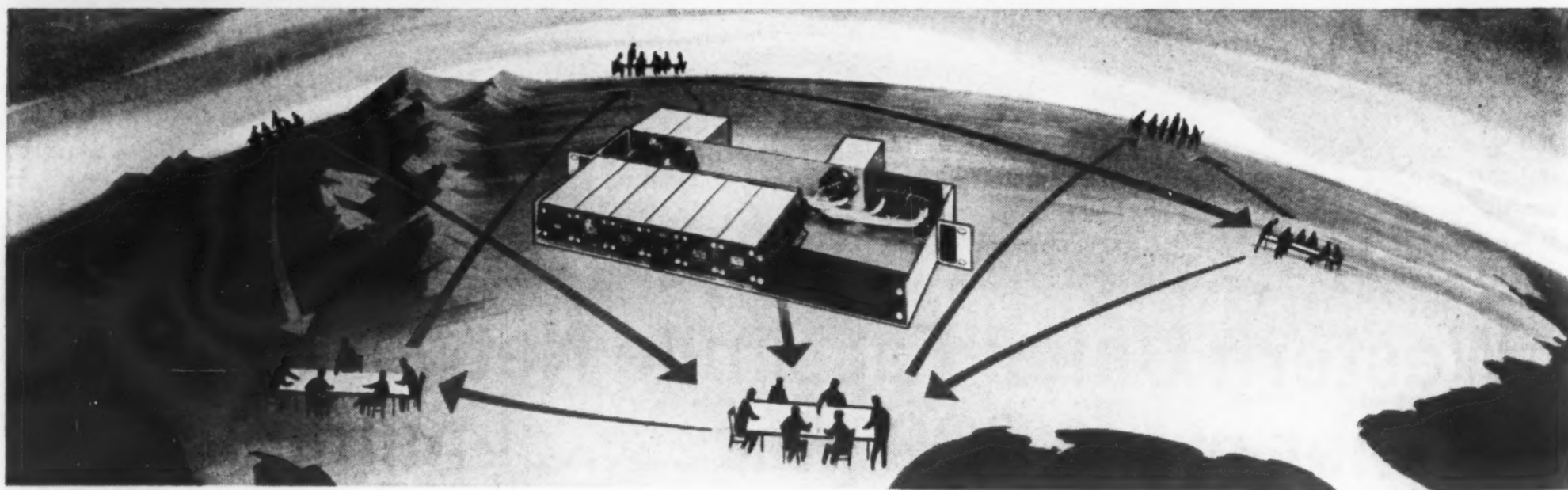
• • •
Dr. G. U. Sorger, who heads the Microwave Standards effort at Weinschel Engineering Co., has been appointed Assistant Professor at the new Institute of Measurement Science of the George Washington University in Washington, D. C.

The new Institute was established in February of this year in cooperation with the National Bureau of Standards and the Martin Company of Baltimore. It is devoted to the study of Metrology, the science of measurements. Courses are offered in optical, thermal and electronic measurements.

Dr. Sorger will teach a course for graduate students in microwave measurements, including measurement of power, frequency, impedance, wave-

(Continued on page 112)

**NEW...ALTEC LOUDSPEAKING TELEPHONE SYSTEM FOR
INTER-OFFICE TELEPHONE CONFERENCES COAST-TO-COAST**



**Important Advance in Military and
Civilian Group Communication Systems**

Coast-to-Coast inter-office telephone conferences with many talkers at each location are now possible with the new ALTEC 7302 Loudspeaking Telephone System. The 7302 is a fully transistorized system that maintains uniform talking and listening levels regardless of distance with speech transmission of such great fidelity that familiar voices are recognizable instantly. With an effective audio coverage of a large size executive office, the system offers freedom of movement and comfortable hands-free operation to large groups of talkers.

The 7302 operates on existing telephone lines in conjunction with type 510 set or equivalent. Associated ALTEC equipment includes the 755C Loudspeaker and one of the following ALTEC Cardioid Microphones:

Models M-30, 683A, or 685A. The 7302 mounts in standard 19" relay rack and occupies only 1 3/4" rack height. Power is supplied to the system from central office or PBX quiet battery supply of 24-26 v DC.

This system—now in use by a nation-wide retailer and a drug chain—provides the answer to their needs for instant consultation among their executives at branch offices throughout the country. With this system, you can now fill the many requests for this type of service from brokerage houses, military command facilities, and any organizations requiring group discussion of problems among specialists in separate locations. For complete information write Dept. S-5-T

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**ALTEC LANSING
CORPORATION**

A Subsidiary of Ling-Temco Electronics, Inc.

1515 SOUTH MANCHESTER AVENUE, ANAHEIM, CALIFORNIA
NEW YORK • LOS ANGELES

ALDEN SCANNERS MARK NEW ERA IN FACSIMILE COMMUNICATIONS

Compact, mobile Alden Flat Copy Scanners are in use today throughout the U. S. Weather Bureau Hi-Altitude Facsimile Network — marking a bright new era of simplified, continuous facsimile communication. And here are the reasons why —

NEW INSTALLATION SIMPLICITY . . . within two hours of air delivery, Alden Scanners at the Hi-Altitude Network were uncrated from their fold-away shipping cases, rolled in, plugged in, and *fully tested* for 60, 90, and 120 RPM quiet and dependable operation.

NEW COPY HANDLING SIMPLICITY . . . map transmission is no longer dependent on exact drum mounting. With Alden's expandable copy feed head, maps of *any width or length* can be scanned, one after the other, fed straight or crooked, *with only one Alden Scanner*. Original plotted maps can now be scanned without cutting to size. Map plotters have originals returned in half the time. Space and maintenance problems are minimized.

NEW CLARITY — NEW SHARPNESS . . . with copy feed rolls precisely positioning surface of the map on the flat copy scanner table, exact focal lengths are maintained for clear, sharp recordings. Focus smudge caused by unusually thick copy or copy lifting from drum is *completely eliminated*.

MEETS ALL FUTURE REQUIREMENTS . . . the practical scanning equipment for a world-wide facsimile map network. Speeds can be easily increased — without reengineering of equipment — for use with coaxial or microwave transmission facilities and computer-processed weather data.

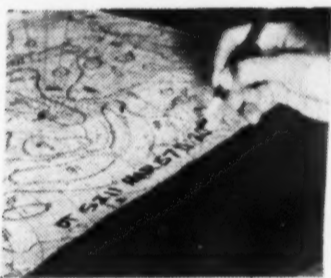
WHAT ARE YOUR FACSIMILE REQUIREMENTS? LET'S GET TOGETHER . . . Alden Flat Copy Scanners and Recorders are available in all sizes (and up to 30 times present network speed) to users and qualified manufacturers. Your inquiry is invited.

HERE'S WHY FORECASTERS PREFER* ALDEN RECORDERS AND ALFAX MAPS AND WHY WE THINK YOU'LL LIKE THEM TOO!

MOST COMMENDED FEATURES OF ALFAX MAPS



Color Is Easiest To Read Under All Lighting Conditions



Ease Of Writing And Erasing Enhances Analysis



Clean Crisp Duplicates By Bruning Or Ozalid

PLUS THESE UNIQUE FEATURES

LOW COST . . . Alfax papers save 2/3 to 2/5 yearly paper costs.

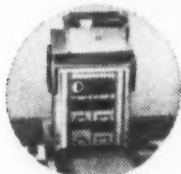
CLEAN . . . Electricity is the Ink . . . Ion deposits make crisp brown marks on clean white background — free from dust, smudge and chemical irritants.

PERMANENCE . . . Alfax stores indefinitely . . . recording marks are permanent.

* Surveys of weather forecasters experienced with all weather facsimile systems, 3 out of 4 indicated a marked preference for Alden Recorders and Alfax Maps.

MOST COMMENDED FEATURES OF ALDEN RECORDERS

EASE OF INSTALLATION
Compact, mobile, and ready for immediate operation.

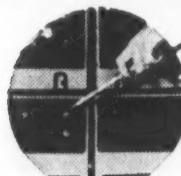


Uncrate



Roll in

EASE OF MAINTENANCE



Front panel checks



Back connector checks

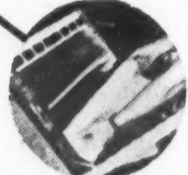


Plug-in construction

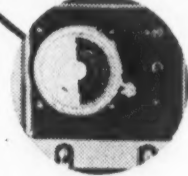
EASE OF OPERATION
A new high in clean, quiet, trouble-free operation



Instant Visibility



Easy Paper Loading



Automatic Time-Clock Programming

PLUS THESE UNIQUE FEATURES

SECURITY . . . Low voltage marking process does not generate a signal that can be intercepted.

HIGH SPEEDS . . . Sixty, 90 or 120 RPM operation — recorder technique and paper capable of 15 times these existing speeds.

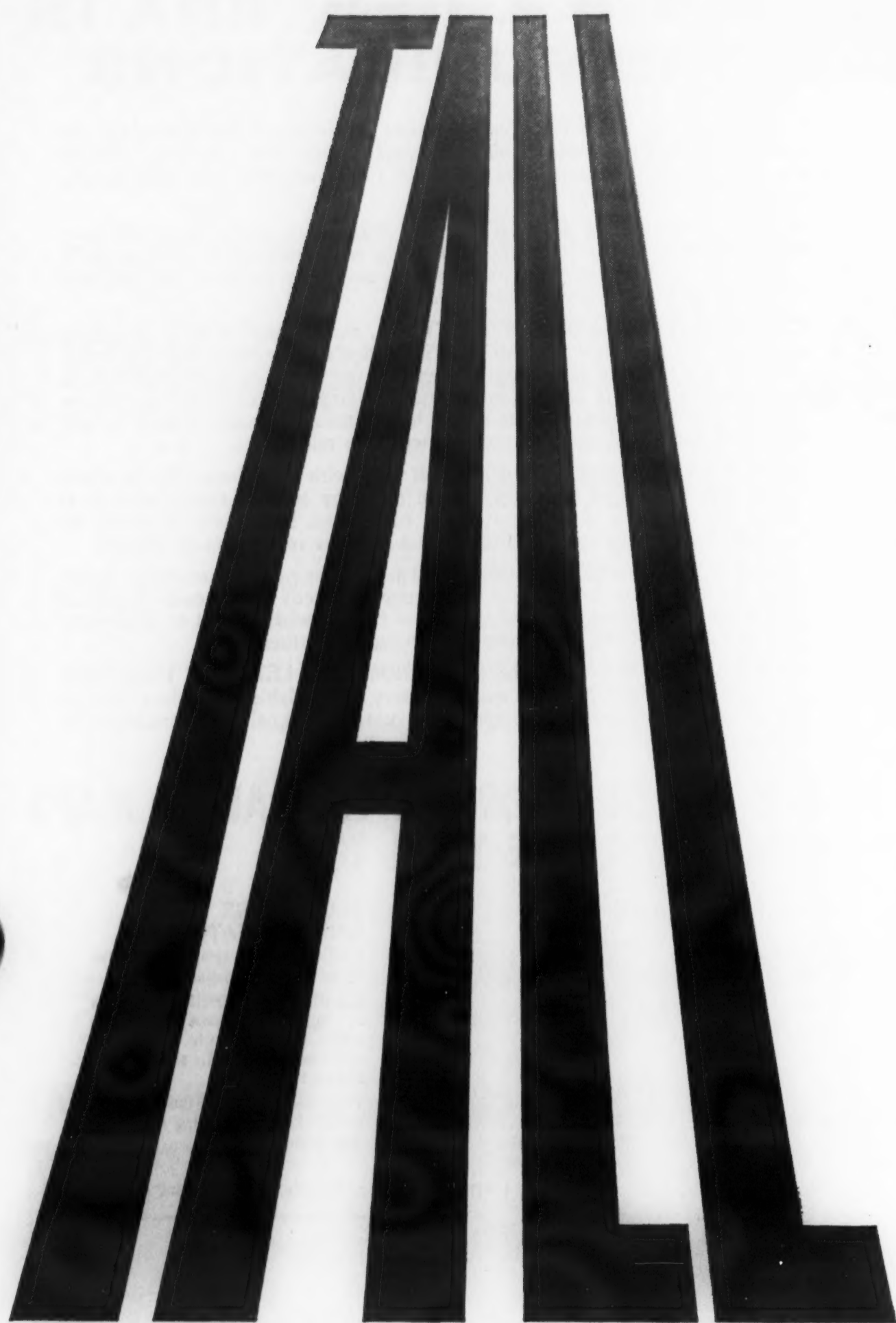
VOLUME PRODUCTION . . . Designed for volume production on short lead time through unique expandable manufacturing processes.



CEILOMETER BREAKTHROUGH

Used with rotating beam ceilometer, Alfax paper and Alden recording techniques replace continuous live scope observation with a continuous pictorial history of cloud conditions. Dynamic tone-shade gradients in warm color reveal all pertinent ceiling information in easy-to-read, easy-to-interpret form. Superimposed dark maximum signal marking shows exact reportable cloud height.

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in telemetry systems management

The ascendant position of Vitro Electronics in telemetry systems management and products stems from the facilities, experience, and talent it takes to produce *on time*. Vitro telemetry capability is demonstrated daily down the AMR and PMR ranges. Management versatility is reflected in our ground, mobile, shipboard, airborne, and space operations around the globe. ■ This specialty of Vitro's trusted electronic competence is founded on long and familiar experience in the functions of telemetry conception, design, engineering, procurement, production, testing, and installation. Where the utmost in exacting telemetry systems performance is demanded — Vitro is at work.

Outstanding opportunities for telemetry systems, RF and advanced development engineers.

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919 JESUP-BLAIR DRIVE, SILVER SPRING, MARYLAND / 2301 PONTIUS AVENUE, LOS ANGELES 64, CALIFORNIA

See VITRO exhibits at National Telemetry Conference, Booths TH81, TH82, Sheraton Towers, Chicago . . . and at AFCEA Show, Booths 71, 72, Sheraton Park Hotel, Washington, D. C.

length and attenuation at microwave frequencies. Also included will be the study of characteristics and Q of resonant devices.

• • •
An experimental storm detection radar will be tested by the U.S. Air Force at Hanscom Field as part of a weather observation and forecasting system designed to modernize weather prediction in the Air Force.

Construction has started on a 70-foot triangular tower to support the compact, light weight (300 pounds) radar. The tower will be located near the Base Operations building at Hanscom.

The radar, which has a circular antenna eight feet in diameter, is scheduled to begin operating in June for a six month trial. Formally known as the AN/FPS-68, the radar was built by the Curtis-Wright Corporation under a Navy contract administered in connection with the Air Force.

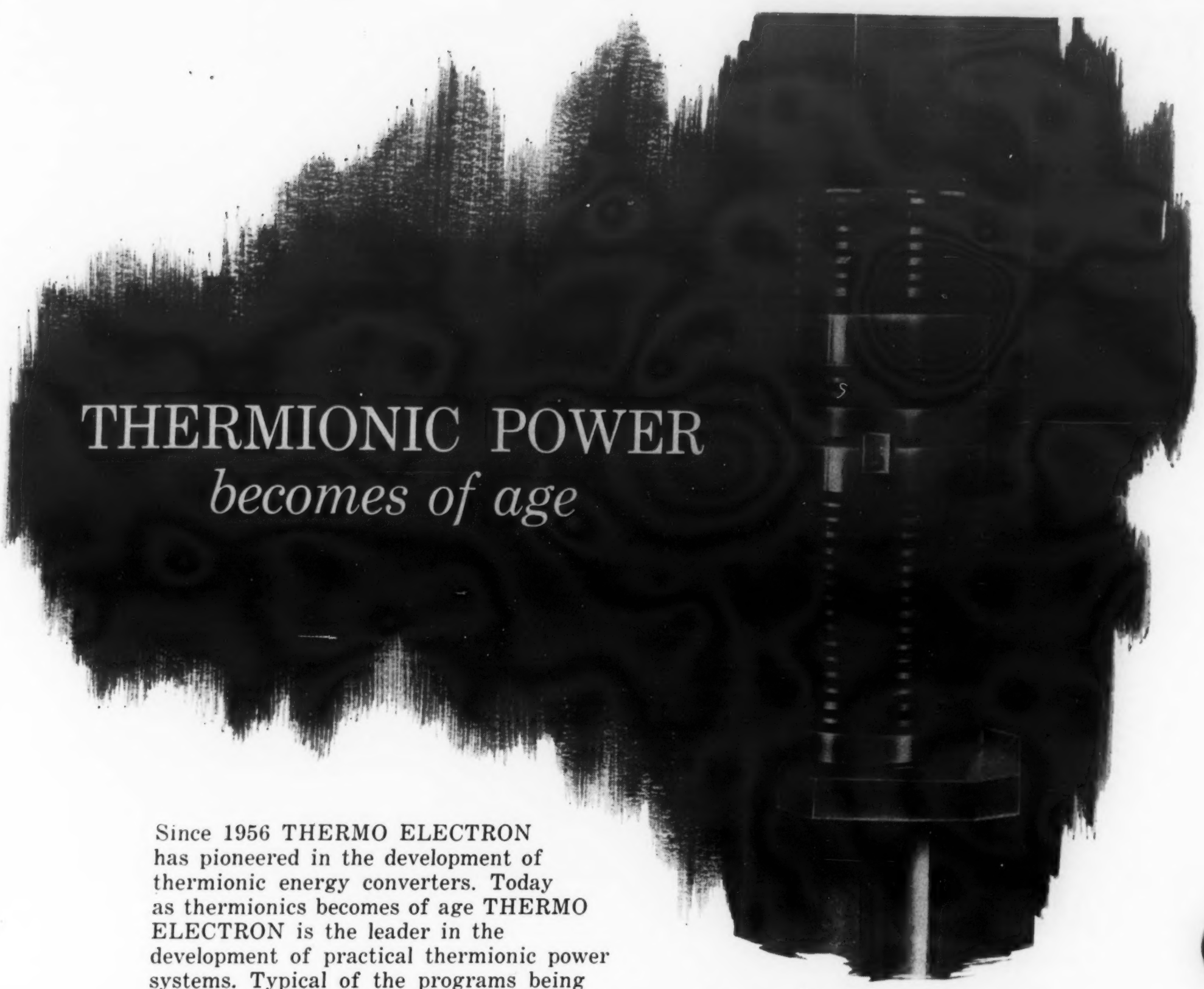
• • •
A closed-circuit television system which utilizes ordinary telephone lines for long distance transmission of pictures has been developed at International Telephone and Telegraph Corporation facilities in Ft. Wayne, Indiana.

The system is known by the trade name Videx and differs from commercial television in that it is slow scan—requiring 15 to 60 seconds to send a complete picture. Electron tube components compress the 3,500,000 cycle bandwidth required for ordinary television to the 3,500 cycle limit of telephone circuits. While direct connection to conventional telephone lines would be the most common linking method, transmission can be achieved via radio voice channels.

• • •
Stephen Yando, of General Telephone & Electronics Laboratories, Bayside, N. Y., presented a paper at the IRE convention in New York City last March describing the prototype of an electronic display device based on a new principle.

The device consists of a thin flat panel composed of an electronic ceramic material, one surface of which is coated with a layer of electroluminescent material. When voltage pulses are applied to several electrodes on the edges of the flat panel, traveling acoustical waves are introduced into the ceramic material. Electric fields which accompany these acoustical waves interact with the

(Continued on page 114)



THERMIONIC POWER *becomes of age*

Since 1956 THERMO ELECTRON has pioneered in the development of thermionic energy converters. Today as thermionics becomes of age THERMO ELECTRON is the leader in the development of practical thermionic power systems. Typical of the programs being carried out for military and peacetime applications are:

A 250-watt solar thermionic generator for Wright Air Development Division for space applications. WADD chose the team of Thermo Electron and Thompson Ramo Wooldridge Inc. TRW provides the system's management and Thermo Electron is developing the thermionic generator.

Isotopic-fueled thermionic generator — The Martin Company selected Thermo Electron to develop this generator which holds promise for applications in space, navigational aids, and remote sites.

A 200-watt gas-heated thermionic generator — the American Gas Association selected Thermo Electron to develop a gas-fired thermionic generator in commercial appliances and in military and industrial field applications.

*These exciting and advanced programs offer challenging opportunities to qualified scientific and engineering personnel. For further information regarding your interest in thermionics contact
L. T. Sullivan, Business Manager.
TWinbrook 4-8700*



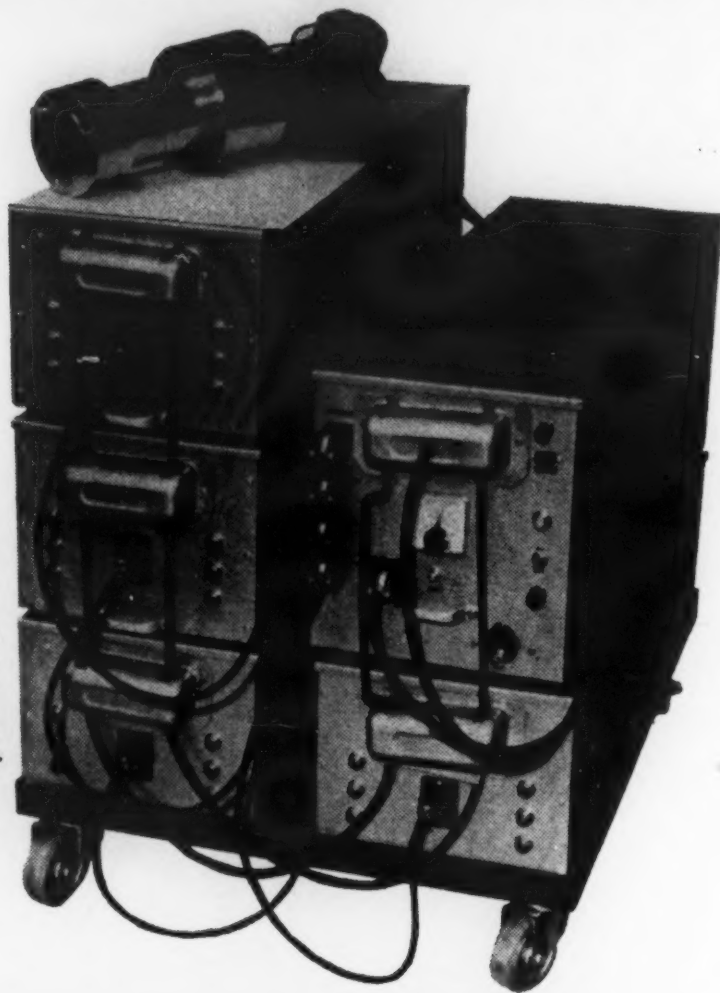
THERMO ELECTRON
ENGINEERING CORPORATION
85 FIRST AVENUE • WALTHAM 54 • MASSACHUSETTS

Leaders in Thermionic Energy Conversion

A "MUST-SEE"

OPTICAL MASER DEMONSTRATION

AT THE AFCEA SHOW



VALPEY-ELECTRO POWERPACS will be operating an Optical Maser to demonstrate: varied power levels, various ruby rod configurations of different diameters and lengths, and types of raw materials.

Special chromium doped rods are fabricated by Valpey from low strain, annealed ruby boules specifically grown for Optical and Microwave Maser applications at 0° or 90° orientations. Depending upon orientation, rods are available up to .750" diameter and 8" in length. End surfaces are polished flat to 1/5 wave and 1/10 wave of sodium light; parallelism to within 1 second of arc or better. Information on other specifications and materials are available.

The Power Supply, by Electro Powerpacs, is specifically designed for optical maser research. With output up to 5000 volts, the Power Supply is capable of furnishing energy up to 20,000 joules at stepless, variable voltages from 1000 to 5000 volts. A separate stabilized voltage supply triggers the flash tube through thyatron circuitry, assuring complete isolation from high voltage circuitry. Complete interlocking of the Power Supply and Capacitor Banks assures personnel safety.

Two types of Ruby Maser Mounting accessories can be furnished, both allowing ruby rods of various lengths and diameters to be mounted in the helix of a standard FT-524 flash tube. One type, with air blast cooling, operates with repetition rates to once every 10 seconds; the other type, with liquid or cryogenic cooling, with somewhat faster repetition rates. Plan to visit this demonstration or if you are unable to attend the show, write for further technical information.

VALPEY - ELECTRO POWERPACS

244 HIGHLAND STREET HOLLISTON, MASS.

electroluminescent layer to produce a 'spot' of illumination on the panel. The position of the 'spot' is controlled by varying the relative timing of the electrical pulses to produce an electronic wave pattern. A technique for continuously modulating the light intensity of the 'spot' was also described.

Designed and manufactured by Stromberg-Carlson, San Diego, the S-C 4000 systems operate as peripheral equipment for the output of large scale digital computers. Output is on 35mm film in the form of plotted curves, tabular data or alphanumeric printing.

Capabilities of the S-C 4020 High Speed Microfilm Recorder are: Recording data on microfilm at 17,500 characters per second; Plotting graphs on microfilm at 12,500 points per second; Projecting selected data on a direct-view screen less than eight seconds after film exposure.

The General Electric Receiving Tube Department is demonstrating a miniature transmitter which uses a single tiny ceramic receiving tube oscillating at 7300 megacycles.

Power output of the transmitter is about 30 milliwatts and its range is approximately 50 feet. Range can be greater, depending on the sensitivity of the receiver. The tube used is a re-entrant cavity version of the 7486.

Packard Bell Computer Corporation, a division of Packard Bell Electronics, has developed a militarized analog to digital converter for measuring ac and dc voltages plus resistance, frequency and period.

The Model M7 Multimeter was developed for use in automatic check-out applications including tests of missiles, space vehicles, radar, computers and other complex electronic equipment. Frequency measurements from one cps to 100 kcs can be made to an accuracy of 0.01% \pm 1 count. A measurement is completed in 0.1 second. Periods from 0.001 to 0.1 second can be measured to an accuracy of 10.01%. Voltage and resistance ranges extend to 1000 volts ac or dc and one megohm.

A new high-speed, word-organized, electrically alterable random access memory developed by the Westinghouse Electric Corporation's air arm division employs multiaperture fer-

(Continued on page 116)



Radiation's TDMS anticipates circuit failure in telegraph and data transmission links without interrupting traffic

Radiation's Telegraph Distortion Monitoring System—TDMS—is a compact, self-contained unit for continuous on-line monitoring, testing and analysis of telegraph and data transmission links.

Its sensitivity to signal distortion is so acute that it can locate and describe equipment misalignment *before* it becomes an operational problem.

TDMS does its job without interrupting traffic and in a language that is easily interpreted by a nontechnical operator. Thus, in our illustration above, a line that is becoming increasingly capacitive can be located and rectified prior to circuit failure.

For detailed information on the TDMS, write Dept. S-5, Products Division, Radiation Inc., Melbourne, Florida. Refer to Bulletin RAD-E-100B.



TDMS performs all of these on-line functions: 1. Distortion transmitter; 2. Test message transmitter; 3. Distortion analyzer; and 4. Linear wave-form analyzer.

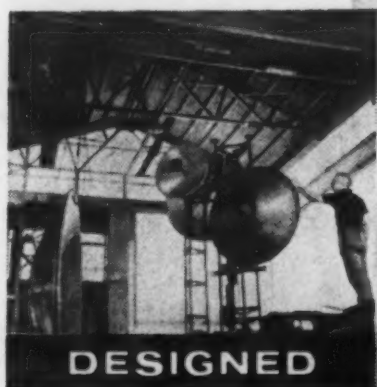
Among available accessories are utility cart (shown above), portable power supply, and relay-test adapter.



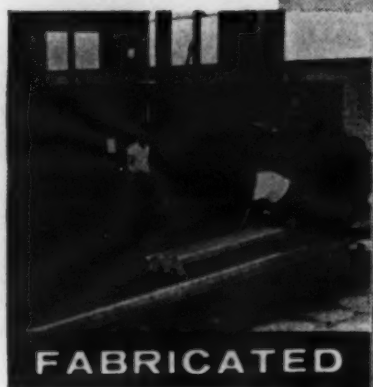
RADIATION
INCORPORATED

TDMS to be displayed at AFCEA. Visit Radiation exhibit, Booths 261-263, Shoreham Hotel.

COMMUNICATION TOWERS



DESIGNED



FABRICATED



ERECTED

by
Stainless

300' Micro-
wave Tower by
Stainless, Inc.

When you need towers—for microwave relaying, radio or scatter transmission—call upon Stainless' experienced staff to handle the whole job—from planning to installation.



Ask today for your free booklet describing many Stainless installations.

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NORTH WALES · PENNSYLVANIA

rite cores and fully transistorized circuitry. Westinghouse states the memory is capable of non-destructive readout and non-volatile storage and thus does not lose stored information either during readout or as a consequence of power shutdown or failure.

A 1024-word prototype model has been operated at an 0.6 microsecond cycle time with an access time of 0.20 microsecond. The model and its memory core stack, drivers, switches, timing circuitry and sense amplifiers have been successfully operated over wide temperature excursions.

As an extension of the development, Westinghouse is presently engaged in developing a 4096-word, 50-bit, electrically alterable, non-destructive and non-volatile instruction memory with tape loading equipment.

The fact that stored program information can be altered by electrically writing new information into the memory permits a new instruction or an entirely new program to be written into the memory under control of a tape reader or other input devices. The process of writing information into the memory cores is done by conventional, coincident-current writing technique.

Sylvania Electric Products Inc. has announced the development of a wideband microwave device. Known as SB-100, the coaxial component acts as a band-pass from 2.5 megacycles to 11,000 megacycles while isolating frequencies from dc to 2.5 megacycles.

Sylvania believes the unit will improve microwave sensitivity by eliminating 60-cycle ground loop currents and providing dc and low-frequency isolation in 50-ohm coaxial systems. At frequencies of 2.5 to 11,000 megacycles, insertion loss amounts to 0.2 db or less, the company reports.

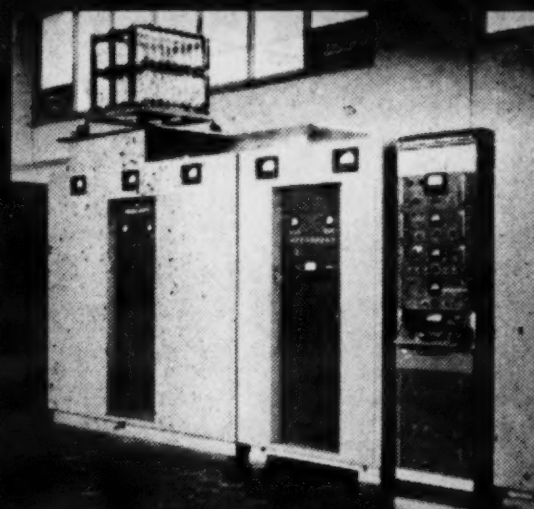
The device is made with N, BNC or TNC coaxial connectors. It is available in three configurations: one providing dc blocking on both the inner and outer conductors, one with blocking on the inner conductor only, and one with blocking on the outer conductor only.

Supplement 1 to the electronic equipment reliability handbook used by the U. S. Air Force Ground Electronic Equipment Research and Development Center, Rome, New York, is available through the Office of Technical Services, U. S. Department of Commerce, Order PB 161 894-1

MAJOR BREAKTHROUGH FOR HIGH and SUPERPOWER SSB

The Kahn Model SSB-58-1B high efficiency Class C SSB Exciter-Driver System, backed by more than 7½ years of continuous use, offers the first major breakthrough for high and super-power military and commercial SSB communications.

There are approximately seventy Kahn installations throughout the world, developing between 40 KW and 4 megawatts PEP.



Typical Kahn Model SSB-58-1A exciter-driver installation on 10 KW high-level AM Transmitter at Radio Swiss near Berne, Switzerland develops 40 KW PEP on SSB. (Picture courtesy of Radio Swiss and Brown Boveri)

- 2½ times more power for a given plate dissipation — thus reducing overall SSB system cost, size, and weight.
- Greater sideband rejection at high and super-power levels.



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Freeport 9-8800

See us at AFCEA Exhibit, Booth #99
Sheraton-Park Hotel

at \$3.50. The basic reliability handbook, *RADC Notebook*, contains specifications prepared by the Center covering both production and development models of electronic equipment, Order PB 161 894 at \$4.00.

Chinese Communist Development of Teleprinter and Facsimile Equipment is the report of a Government survey and analysis on the subject and is considered a partial index of Red China's electronic engineering capability. Order 60-21917 from the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce for 75 cents.

The following reports are also available from the Business and Defense Services Administration. *Foreign Developments in Machine Translations and Information Processing* includes translated literature on the Speech Statistics Conference; linguistic probability, symposium on problems of speech discrimination; and, development of structural and mathematical methods of language research. Order 61-11737 for 50 cents. *A Survey of Computer Programs for Chemical Information Searching*, Technical Note 85, describes twelve computer systems for searching. The report discusses various chemical notation systems, indexing and abstracting procedures, punched card systems and special purpose literature searching machines. Linguistic and other difficulties involved in literature searching are also discussed. Order PB 161 586, for \$2.25.

The Research and Policy Committee of the Committee for Economic Development (CED) has outlined nine "immediate and important steps" to be taken in cooperation with the twenty Latin American Republics to promote economic and social progress "essential for the maintenance of stable democracies."

The 64-page report, *Cooperation for Progress in Latin America* is available from Committee for Economic Development, 711 Fifth Avenue, New York 22, N. Y.

A booklet which tells how to build negative-ion generators and how to measure their ion output is now available from The Westinghouse Electric Corporation.

For a copy of booklet CE 860, write to Westinghouse Lamp Division, MacArthur Avenue, Bloomfield, N. J.

Research and development in the field of semiconductors—transistors, crystal diodes and related devices—amounted to more than \$70 million in 1959—the latest year for which figures are available—the Business and Defense Services Administration of the Department of Commerce has reported. Private industry underwrote more than \$54 million of this total, and U. S. Government agencies, primarily the Department of Defense, the remaining \$16 million.

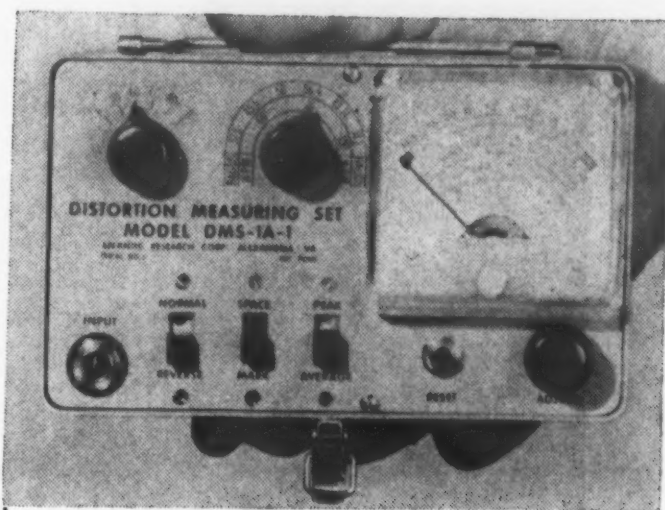
The data are contained in a publication, *Semiconductors: U. S. Production and Trade*, prepared by BDSA's Electronics Division on the basis of a survey of more than 60 semiconductor manufacturers. The material is based in part on information gathered in the course of BDSA's industrial mobilization activities, and also on certain studies by the Department of Defense. The publication is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 15 cents.

The National Electronics Conference, Inc., and a local group of Engineering Management Personnel are sponsoring a Chicago area electronics research and development study. Purpose of the project is to analyze the current status of Chicago area electronics in order to determine whether its R & D potential is being adequately realized, and to add to the present understanding of the relationships between R & D in industry and the benefits of such R & D to the industrial firm and the community.

NEC Electronic R & D Study is currently being conducted under the guidance of Albert H. Rubenstein, Professor of Industrial Engineering, Northwestern University.

Bulletin GER-1704, 16 pages, describes General Electric's integrated a-c electrical system aboard the all-weather Mach II aircraft, F4H. The Bulletin includes a discussion of system components: hydraulic constant speed drives, fine frequency and parallel control unit, a-c generator and protective panel, static exciter-regulator, as well as an explanation of the system's operation.

Schematic diagrams, technical drawings, and photographs of the equipment are also shown. Contact General Electric Company, Schenectady 5, N. Y. for further information.



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Newark Controls Co., Bloomfield, N. J., has prepared two reference data tables for use by design engineers concerned with altitude pressure and altitude density, and specification of environmental controls for measurement and monitoring. Standard pressures (lb/in²) and densities (10⁻⁶lb/ft³) are given for each 100 feet of altitude from 0 to 100,000 ft.

Copies of these tables are available upon request to Newark Controls Co., 15 Ward St., Bloomfield.

The National Bureau of Standards has recently improved its services for the calibration of inductive voltage dividers.

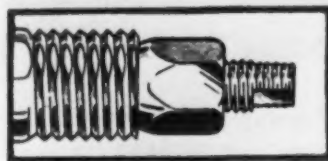
With the aid of special capacitance bridges, extremely accurate calibrations are given for this type of device. Inductive voltage dividers can be calibrated at NBS by comparison with the standard. The comparison method is simple and should find widespread application in many other standardizing laboratories.

A European Translation Center, sponsored by 12 member countries of the European Productivity Agency,



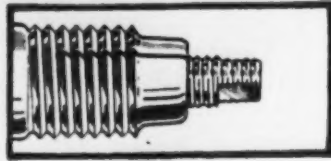
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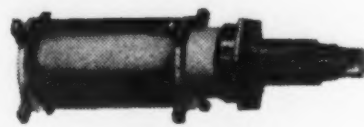
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has been established at the Technical University at Delft, Netherlands. John C. Green, Director of the Office of Technical Services of the U. S. Department of Commerce, reports the new cooperative effort between the U. S. and the European countries will provide broader Western World distribution of translations of Russian and other Eastern European scientific literature.

The Center will provide liaison among European countries handling Russian and East European translations; serve as a center for bibliographic information on the availability of translations; and collect non-commercial translations from countries prepared to contribute them.

OTS is currently assisting the European Translation Center in establishing its procedures for bibliographic and other work. It is contemplated that the OTS publication *Technical Translations*, will be used as the announcement medium for material collected by the European Center, Mr. Green said.

The impact of scientific and technological progress on society is being examined in more than 200 research projects at U.S. colleges, universities and other nonprofit institutions. These studies are described in a National Science Foundation publication, *Current Projects on the Economic and Social Implications of Scientific Research and Development*, 1960. Copies of the publication are available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C., for 40 cents a copy.

Minimizing the Effects of Nuclear Radiation on Electronic Equipment, Bulletin ETD 2564, is available from General Electric's Receiving Tube Department, Owensboro, Kentucky.

Known effects of pulse and steady-state radiation on various types of circuits and components are reviewed.

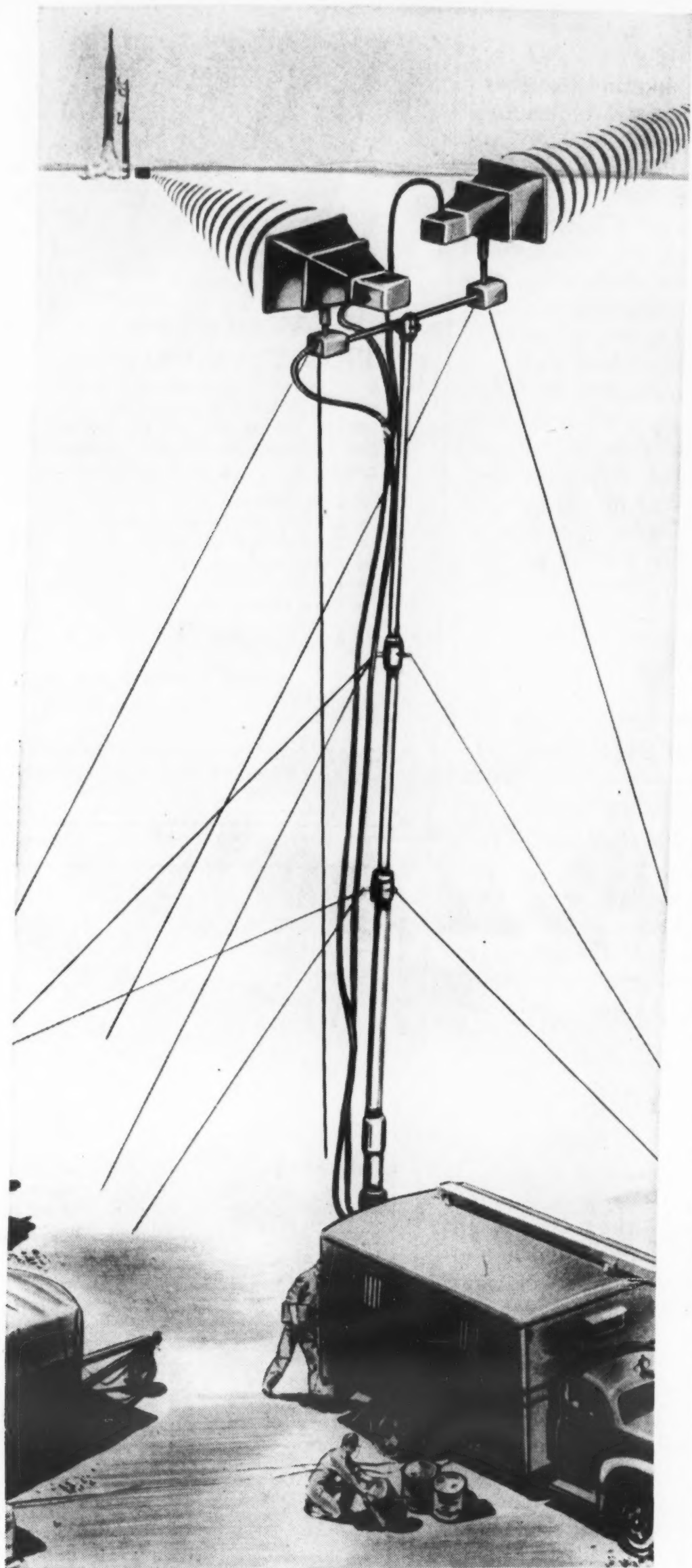
Four different applications using digital time signals to coordinate remote equipment in complex instrumentation and data-processing systems are described in an 18-page brochure available from Hallicrafters Company.

Examples include: airborne reconnaissance with automatic data logging; ground timing system for test ranges and missile sites; data processing with time compression and

(Continued on page 120)

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Standard MM-18 Microwave packages are available from RCA to provide extremely flexible communications systems for mobile applications. Similar to famous RCA equipment that has been proved in use by over a million channel miles, this MM-18 Mobile System provides a broad radio highway over which many teletype channels and duplex voice channels can be operated simultaneously. The directivity of the radio beam and the multiplexing of the communication channels assure a high degree of security for transmitted messages. Truck-mounted, the portable RCA Microwave System also includes a tower that can be rapidly raised and easily transported from one place to another. RCA Mobile Microwave performance matches the reliability found in fixed stations.

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- Command posts to remote launching pads.
- Command post installations for field maneuvers.
- Siting teams requiring high mobility.
- Emergency installations—Civil Defense.

Experienced Microwave engineers will gladly provide additional information. Contact RCA, Dept. U-291, Bldg. 15-1, Camden 2, N.J. or telephone WOODLAWN 3-8000, Extension PC-4560.

Also, New MM-600 Microwave Systems. Long haul, high-density systems for fixed installations. Designed to comply with CCIR/CCITT performance standards. Channel capacity of 600 frequency-division multiplexed voice circuits plus service and alarm channel. Alternately, one r-f channel will accommodate 525-line monochrome television; NTSC color TV or 685 CCIR television.



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Requests should be mailed to The Hallicrafters Company, 4401 W. Fifth Ave., Chicago 24.

• • •

An eight page bulletin describes and illustrates the Speed-Tronik automatic check-out system recently introduced by the Audiotronics Company, Dayton, Ohio.

Speed-Tronik is an all-parameter automatic testing system capable of checking any characteristic convertible to an electrical equivalent. The system checks ordinary voltage and current and also modulated and unmodulated frequencies up to the 3000 megacycle range as well as pulses with very low rise time and duration. Complex wave form analysis is also possible from a minimum amplitude of 30 microvolts. Free copies may be obtained by writing to Audiotronics Company, Box 2187, Dayton 29, Ohio.

Photoprogress

Canadian inventor Gilbert L. Hobrough of Hunting Survey Corporation, Toronto, received the 1960 Fairchild Photogrammetric Award for his contribution to the science of map making—an electronic automatic system for making maps known as Stereomat. The award was presented at the 27th annual meeting of the American Society of Photogrammetry held in Washington, D. C. last March.

The Stereomat performs electronically a function similar to human depth perception, which will automate and speed up a key step in construction of contour and relief maps. Stereomat uses the optical and mechanical parts of a conventional plotting instrument; parallax sensing is by electronic means, and servo motors provide the motions necessary for clearing parallax. Stereomat automatically performs relative orientation, contouring, profiling and the plotting of drainage. It also assists the operator during absolute orientation and the plotting of planimetry. The production of ortho-photographs directly from Stereomat appears feasible to Hobrough and is expected in the near future.

• • •

An underwater, photographic spectrophotometer able to simultaneously record light intensities throughout



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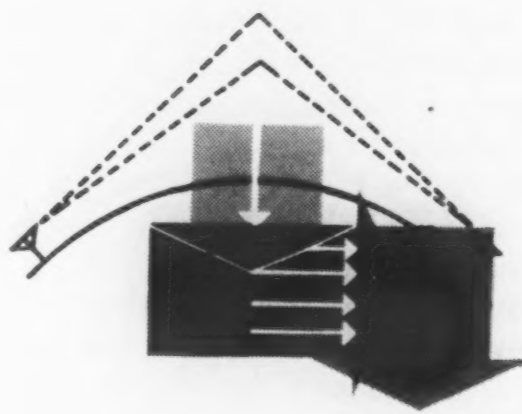
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the visible spectrum at a relatively high photographic recording speed has been developed by the Navy. The use of a wedge interference filter as the analyzing element is the key to the spectrophotometer's speed and sensitivity.

The device is capable of direct measurement of the spectral composition of transmitted and scattered light at depths of 200 feet. Purpose of its development is to gather data on the spectral distribution of energy in incident and scattered light as an aid in choosing the best combinations of film types, lighting, and filters for underwater photography. Further tests and design refinements are being made to extend the capability of the spectrophotometer to greater depths.

A report on the spectrophotometer may be obtained by ordering PB 161 774 from the Office of Technical Services, U. S. Department of Commerce, Washington, D. C., for 50 cents.

Television Station KPHO-TV, Phoenix, Arizona, successfully telecast a seven minute interview which had been recorded, processed and projected with slight adaptation using 8mm sound movie camera equipment.



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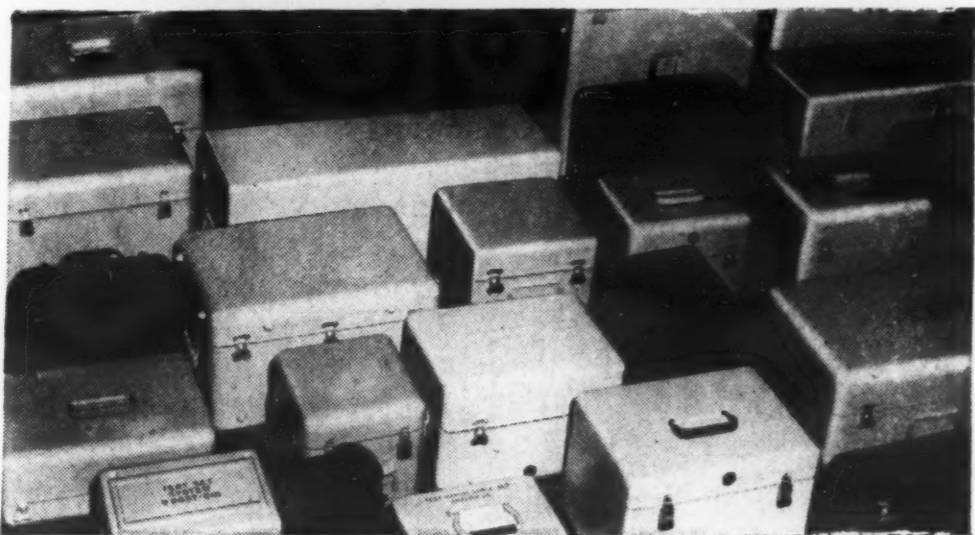
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The equipment included a portable, 8mm handheld, sound movie camera; companion 8mm sound projector and a rapid film processor—all manufactured by the Industrial Products Division of Fairchild Camera and Instrument Corporation.

The camera permits about $2\frac{3}{4}$ minutes of shooting time on each half of a 50 foot film roll. The spool is then reversed giving a total shooting time of approximately 5 minutes. For Station KPHO's purposes, two pre-stripped films were used, DuPont 931 and Eastman Kodak's Tri-X. Film on a 50 foot spool went directly to the film processor for negative developing at about 6 feet per minute. The film was then split to the 8mm size, spliced and run through the specially adapted sound projector. Electrical polarity of the tube output was then reversed giving the screen a positive image.

• • •

The Jet Propulsion Laboratory, California Institute of Technology, reports that four cameras aboard the Surveyor spacecraft will send television pictures of the moon's surface back to earth, each camera transmitting pictures at the rate of one every few seconds.

Present National Aeronautics and Space Administration plans call for seven Surveyor spacecraft to be launched to the moon in the period 1963-1965. JPL will provide technical direction for the project which is expected to cost upwards of \$50 million. Hughes Aircraft Company has been selected for contract negotiations to build Surveyor.

Surveyor will weigh some 2500 pounds when it is injected into the lunar impact trajectory. After the retro rocket fires and it lands on the moon, Surveyor will weigh 750 pounds, 200 pounds consisting of working scientific and engineering instrumentation.

As Surveyor approaches the moon, the television cameras will be turned on automatically and pictures of the lunar surface will be transmitted back to earth. Three of the cameras will be pointed up and one down, all fixed in position. Above each of the upward viewing cameras is a gimbal-mounted mirror capable of directing the television cone of vision through 360° of azimuth and from 15° above to 45° below the horizontal line of the spacecraft.

• • •

A new class of radar simulators using a pair of images on a photographic plate as the information input for the system is described in a

paper to be presented at the annual convention of the Society of Photographic Scientists and Engineers. The paper, *Photographic Plates as Computer Memory Devices for Radar Simulators*, authored by R. J. Entwistle of the U.S. Naval Training Device Center, Port Washington, N. Y., is being presented at the SPSE convention in Binghamton, N. Y., May 22-26.

The photographic information is designed to permit the simulation of flight of a radar-equipped aircraft on any path within the plate's boundaries. The data used to generate the radar display is stored on 16" by 20" photographic plates and read out with a flying spot scanner image which is reduced to duplicate the pulse coverage of the radar. The plate is moved to simulate the speed and direction of the simulated aircraft.

Radar display data are contained in two adjacent images which are identical as far as map area and scale are concerned. One image contains land mass data and topographic elevation is represented by the photographic density of the image. The second image contains hydrographic and other radar reflectance data and the variation of radar reflectance is represented by a series of photographic densities.

• • •

A new model of the Kodak Retina Reflex Camera, introducing dual photoelectric exposure control, has been announced by Eastman Kodak Company.

The Kodak Retina Reflex III Camera is available with either 50mm f/2.8 or 50mm f/1.9 lens. A two-way automatic exposure control system allows the operator to make exposure settings either by looking through the view finder or by viewing a small opening at the top of the camera.

• • •

GPL Division, General Precision, Inc., is manufacturing a closed-circuit television camera designed to explore pipes as small as four inches in diameter. The camera is reported as watertight to a depth of 10 feet and 5 psi pressure. A built-in light source of 30 ft. candles at one foot and a removable rotating mirror for axial or radial viewing are included in the camera's design.

• • •

Technical Animations, Inc., Port Washington, New York, is providing one-week training courses in the use of Technamation, the method of creating an animated image from a

static black and white or color transparency. Technamation permits an animated presentation to trace directional flow of electricity, fluids or gases; observation of how a complete system or components operate; the study of sequence of operation; the study of the relationship of a component's operation within a system and aid in transition from simple to complex training operations.

The course, given at Technical Animations, Inc., is open to all training aid specialists in government and industry.

Names in the News

Glenn E. Matthews of Eastman Kodak Co., has been elected Editorial Vice-President of the Society of Motion Picture and Television Engineers to fill the two-year term left vacant by the death of Lloyd Thompson.

Dr. Deane R. White, Engineering Vice-President of the Society of Motion Picture and Television Engineers has been named a member-at-large in the Division of Engineering and Industrial Research of the National Research Council. Dr. White is Associate Research Laboratory Director, E. I. du Pont de Nemours & Co.

Brother B. Austin Barry, F.S.C. from the Civil Engineering faculty of Manhattan College, has been elected President of the American Congress on Surveying and Mapping.

Walter S. Dix, liaison officer in Washington for the T.V.A. Maps and Surveys Branch, was elected Vice President.

Arthur J. McNair, Professor of Civil Engineering and head of the Surveying Department at Cornell University, has been elected President of the American Society of Photogrammetry for 1961-62. **James P. Webb** of the Army Map Service is the new First Vice-President and **Robert S. Quackenbush, Jr.**, the new Second Vice-President.

Col. Burnis M. Kelly, USA (Ret.), has been appointed assistant to the president, Stancil-Hoffman Corp.

Carmen J. Auditore has been promoted to the new post of manager of systems planning, Military Products Division, Adler Electronics, Inc.

George F. Benoit has been appointed director of engineering, Sanborn Co.

Dr. Leonard S. Sheingold, Director of the Applied Research Laboratory of Sylvania Electric Products Inc., has been named Chief Scientist of the U. S. Air Force.

Robert F. Halligan has been elected president of The Hallcrafters Co.

Robert E. Lewis has been elected president, chief executive officer and a director of the Perkin-Elmer Corp. of Norwalk, Conn. Mr. Lewis was formerly president of Sylvania Electric Products Inc. Richard S. Perkin, president of Perkin-Elmer since 1939, remains as Chairman of the Board.

Will I. Bull (Capt., USN, Ret.) has been appointed director of operations, Semiconductor Division, Hoffman Electronics Corporation.

Louis H. Niemann has been named manager, government and industrial marketing, CBS Electronics.

Col. Harold McDonald Brown, who has commanded the U. S. Army Research and Development Laboratory, Ft. Monmouth, N. J., since May 1958, has received the Chief Signal Officer's Certificate of Achievement for Meritorious Service.

Lt. Col. James A. McClung, assistant executive officer, U. S. Army Signal Research and Development Laboratory, has retired from active duty of the Army.

William W. Dodgson, Jr., is president of the newly established Systems Engineering Laboratories Incorporated, Ft. Lauderdale, Florida.

George T. Scharffenberger has been promoted to executive vice president of Litton Systems, Inc., and will continue in his position as president of Westrex, the communication and recording equipment division of Litton.

Kenneth E. Fields (Brig. Gen., USA, Ret.) has been elected executive vice president of the Bulova Watch Co.

Robert P. Dutton has been elected vice president Government Representation, Collins Radio Company.

E. C. Bennett has been appointed manager, Naval Operations Product Planning, Heavy Military Electronics Department, General Electric Company.

H. A. Timken, Jr., has been elected president of the National Rocket Club.

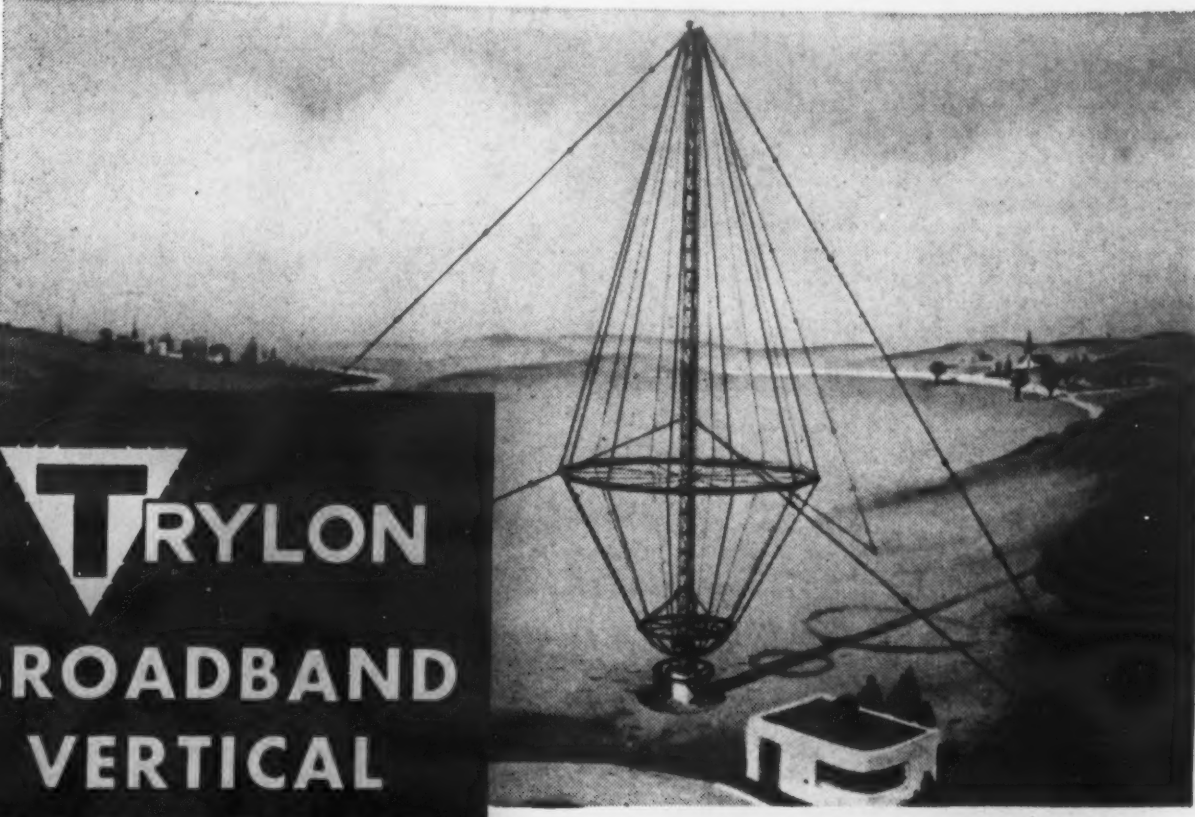
James E. Burnett is president of the newly formed Frontier Electronics Company, Cleveland, Ohio.

Anthony R. Pignoni has been appointed director of Marketing for R. E. D. M. Corp.

Col. James M. Kimbrough, Jr., has been appointed commanding officer of the U. S. Army Signal Research and Development Laboratory, Ft. Monmouth.

Dr. Ralph D. Bennett is director of Research for the Martin Co. in Baltimore, Md.

Arthur C. McCarroll has been appointed public relations director of Hoffman Electronics Corp.



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U. S. Citizen <input type="checkbox"/> or Citizen of: Ham Radio Call:		
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Enclosed find \$ for annual dues for AFCEA membership (or subscription) which includes the monthly magazine SIGNAL and Chapter Affiliation.		
DATE: SIGNATURE:		

Why SIGNAL?

Here are several good reasons why an AFCEA-SIGNAL membership is of importance to you.

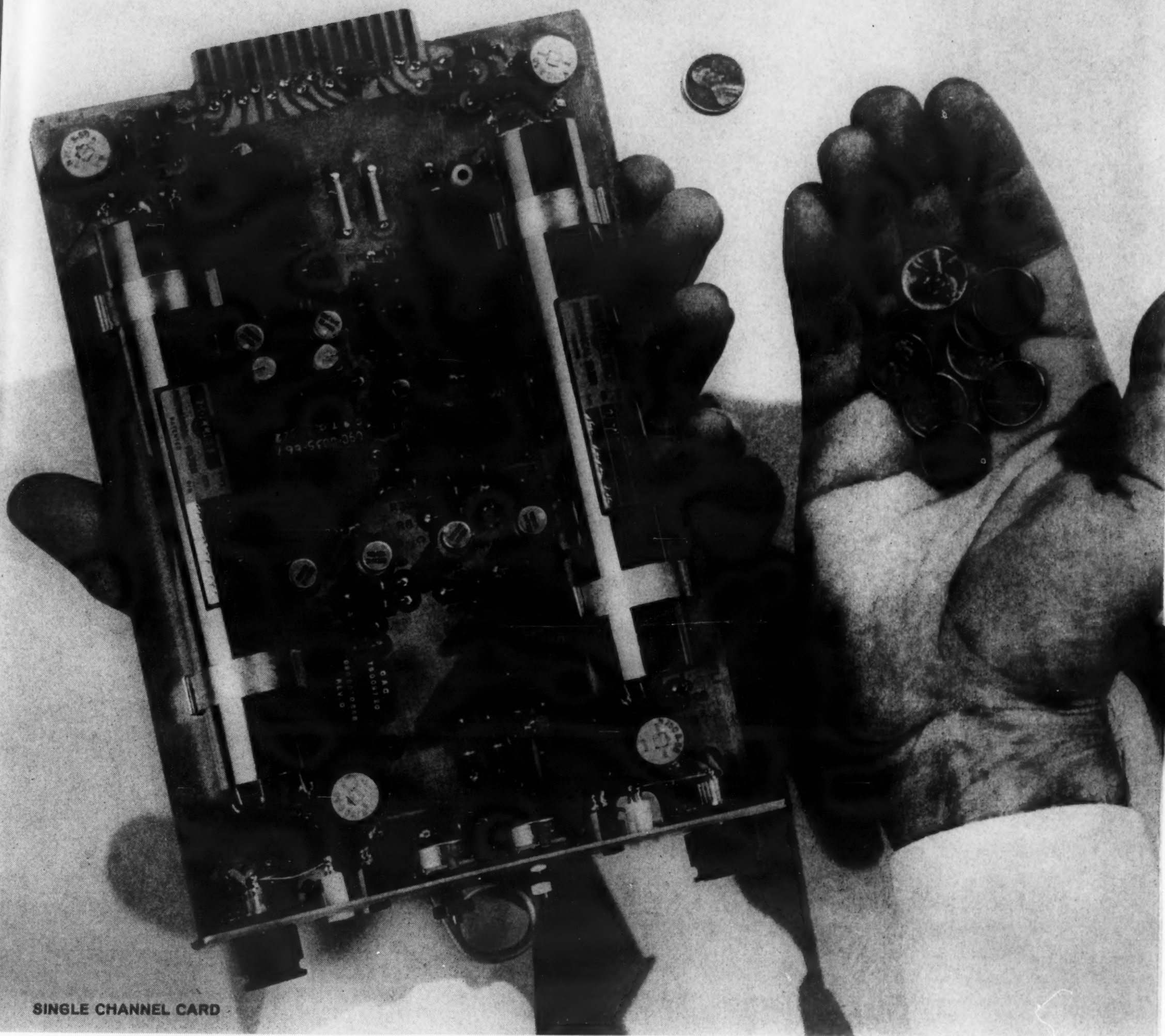
- Representing industry, government and all the military services, AFCEA creates a congenial climate for the members of the civilian-military team to discuss and solve problems of mutual interest.

- SIGNAL Magazine provides its readers with the best information on timely subjects and major developments of professional interest in the communications, electronics and photographic fields.

- SIGNAL gives its advertisers an opportunity to present facts about services, products and achievements to a specialized audience.

- The AFCEA Convention guarantees a top side audience to hear presentations of technical papers on the latest communications-electronics achievements, and to view an entire display of products and services in an atmosphere of a masterfully coordinated technical trade show.

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See Collins MX-106 at AFCEA Convention booths 228-235, Shoreham Hotel, June 6-8.

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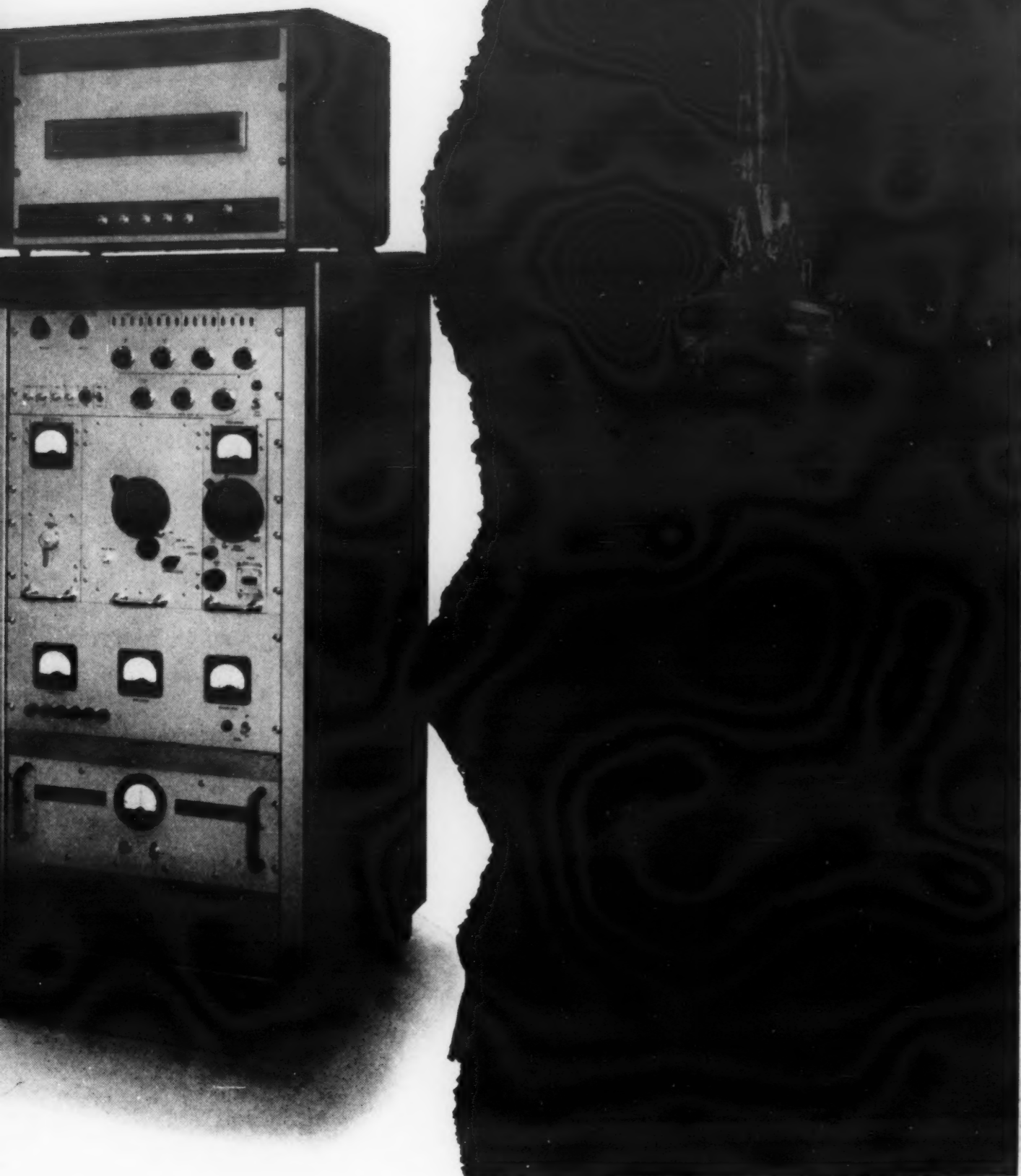
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